The Foundry Trade Journal

AND

PATTERN-MAKER.

THE OFFICIAL ORGAN OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.

Vol. 8. MAY, 1906. No. 53.

——PUBLISHED——
THE FIRST WEEK IN EACH MONTH BY
EAGLAND & Co., Ltd.,
165, STRAND, LONDON, W.C.

Devoted to the interest and advancement of the Iron, Steel and Brass Foundry Trades.

Subscription Terms: 7s. 6d. per annum, post free.

To place the "Journal" within the reach of Working Moulders and Pattern-makers the Proprietors will accept subscriptions, not less than three in number from one shop at the reduced rate of 5/- per annum, such order to be countersigned by the superintendent or foreman of the shop as a guarantee of good faith.

Any Subscriber having difficulty in obtaining copies promptly should notify the Publisher of the "Foundry Trade Journal," 165 Strand, London, W.C., giving the name of his local newsagent.

WE INVITE PRACTICAL ARTICLES ON THE TRADE IN ALL ITS BRANCHES, WHICH WILL BE PAID FOR. MSS. SHOULD BE WRITTEN ON ONE SIDE OF THE PAPER ONLY.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of
THE FOUNDRY TRADE JOURNAL,
165, Strand, London, W.C.

AGENTS.

Bradford: H. M. Trotter & Co., Albion Court, Kirkgate.
Glasgow: Wm. Holmes & Co., Ltd., 9, Mitchell Lane.
Darlington: Walker & Wilson, 2, Park Lane.
Huddersfield: Charles H. Pickles, Pack Horse Yard.
Middlesbrough: Joseph Parkin, 4, Bridge Street West.

BRITISH FOUNDRYMEN'S ASSOCIATION.

A MEETING of the members of No. 2 Birmingham Branch will be held in the Municipal Technical School, Suffolk Street, Birmingham, on Saturday, May 19, 1906, when a paper will be read by Mr. A. H. Hirons, Head of the Metallurgical Department, Birmingham Technical School, on "Effect of some Chemical Elements on Cast Iron."

The chair is to be taken at 7 p.m. All members are cordially invited to attend.

F. W. FINCH,
Hon. Secretary.

NEW FOUNDRY OF J. HOPKINSON AND COMPANY, LIMITED, HUDDERSFIELD.

A BETTER equipped, more efficiently arranged, and more completely organised manufactory than that of Messrs. J. Hopkinson & Company, Limited, of the Britannia Works, Huddersfield, it would be difficult to find throughout the country or abroad.

For over half a century Messrs. Hopkinson have been specialists in boiler fittings, valves, and other steam appliances. Their first products were high-steam and low-water safety valves, produced in 1850. Since that year the firm have continued to introduce improvements both in design and manufacture of all boiler fittings. The first works were established in 1843. As business grew they were developed, and a few years ago it was found impossible to meet the increasing demand for boiler fittings and valves at the old premises, and it was decided to build new works. A site was secured just outside the town of Huddersfield, and plans were prepared, and the result is a manufactory in which not only economy and efficiency of production, but convenience and the comfort of the workers are secured. The premises, built in 1904, were organised and equipped with the following principles in mind:—Specialising on the manufacture of high-class boiler mountings and valves; using all the latest labour-saving devices, best tools, rapid means of transportation, so that high-class interchangeable work can be obtained at the lowest possible cost; manufacturing in quantities to stock, so as to ensure quick delivery against customers' requirements; the adoption of a complete system of gauge working and inspection, by which means the highest class of workmanship is secured. The standard designs are the result of over 60 years' experience in the manufacture of valves and boiler mountings for pressures up to 400 lbs. per square inch. With a view to improving, if possible, upon the quality of their work,

the Company have augmented their tool room with special plant, without which, of course, good work on the interchangeable system is impossible. The approximate area of the ground secured by the Company is 13½ acres, of which about 4 acres are at present covered by the factory. Some 600 hands are engaged, and the manufacturing floors are on one level. All departments are connected by means of tramways, and by the use of electric and other cranes the work can be handled quickly. The driving power throughout the factory is electricity, generated at the Company's own power house.

In the showroom, the first place the visitor is asked to inspect, full-sized model boiler fronts are exhibited, equipped with mountings in accordance with the Company's latest practice, and as adopted in the most up-to-date steam-generating plants. In the boiler house the arrangement of the steam pipes, valves, and boiler mountings is designed with a view to displaying, under actual working conditions, the various and latest specialities produced by the Company.

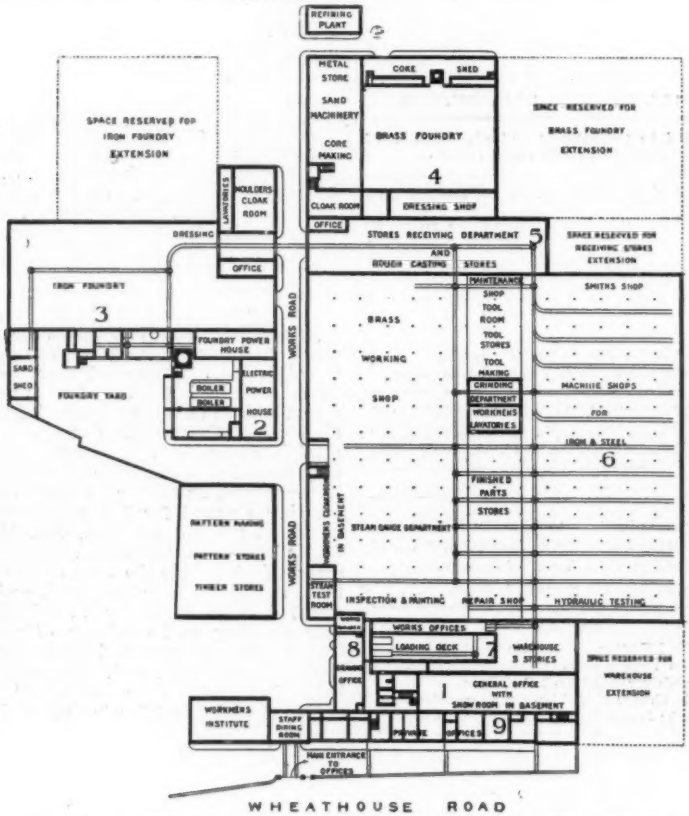


FIG. 1.—GROUND PLAN.—J. HOPKINSON & CO., LTD., HUDDERSFIELD.

The electric generating plant consists of two sets of combined compound engines and compound-wound generators for continuous current at 220 volts. The main switchboard is of blue dove marble with copper-finished mountings arranged with separate panels for power and lighting, from which feeders are carried to distributing boards in various departments of the factory, the cables being carried in a subway which passes under

the shop floor, which also serves as a pipe way for various water and heating mains. The factory is illuminated by arc lamps of the semi-enclosed type. The motors are of two standard sizes, 10 and 20 h.p., interchangeable and of the slow-speed type, driving to their respective line shafts by means of chains.

Leaving the generating station by way of the boiler house, the visitor passes into the foundry yard, where are seen the principal adjuncts to the foundry, such as sand stores, sand-preparing

FIG. 2.—IRON FOUNDRY.—J. HOPKINSON & CO., LTD., HUDDERSFIELD.

machinery, core-drying stoves, coke stores, and cupola, the stage for which is constructed entirely of steel, provides ample accommodation on the charging floor for several days' supply of material, and is served by a hydraulic lift. On entering the iron foundry the visitor will notice the good light and height of the buildings, and the manner in which the foundry is equipped. Here the comfort of the employés has been fully considered, and every facility is provided for securing cleanliness and ventilation. The main iron foundry, having a moulding floor space of 16,000 sq. ft., has two bays of 40 ft. span by 200 ft. long.

The brass foundry is a lofty and light building of two main bays, each 40 ft. span by 100 ft. long, and, like the iron foundry, has good light and ventilation. The foundry is provided with annexes for the storage of coke and dressing castings. In connection with this section are spacious cloak rooms, and lavatory accommodation for the moulders, the whole of which comprises a floor area of 16,800 sq. ft. The receiving and casting stores are 180 ft. long by 40 ft. span, and here all brass, iron, and steel castings, etc., are received, and carefully inspected before being distributed to the various machines. A tramway running from the far end of the iron foundry across the main road and traversing the whole length of these stores, with branch lines, serves the purpose of distribution.

The machine shop, a finely arranged building, 280 ft. wide by 260 ft. long—representing a floor space of 72,800 sq. ft.—has a roof of the saw-tooth type, glazed on the northern slope and painted inside

with a pale blue on the slated slope, which reflects a soft and pleasant top light into the shops. Being in direct communication on the one side with the casting stores, and on the other with the warehouse and shipping departments, the shop is in the best situation for dealing with the machining of work in progress, as also the inspecting and delivering of finished goods. The machine shop is divided into two main sections, known respectively as the "Iron and Steel" side and the "Brass" side. Midway between these two main sections are situated the maintenance department, tool room, grinding and polishing room, the finished parts stores, and lavatories, which are common to both sections. On the "Iron and Steel" side are the heavy machines, also the assembling, testing, inspection, and painting bays, which are served by overhead travelling cranes and tramways, and a number of light jibs over the erecting tables.

Special hydraulic appliances are fixed at many convenient points for testing at various stages of manufacture, so that no defective part can possibly go forward to a later operation without being detected, thus securing reliability for the work. On the "Brass" side are various types of brass-finishing machines and special plant designed for dealing rapidly with large quantities of work, and at a point convenient to both sides is a large steam-testing department, through which work passes, and where a boiler, steaming daily, and capable of supplying steam for testing purposes up to 400 lbs. per square inch, is installed. On this side also is a temporary pattern shop, provided with a modern equipment of the latest wood-working tools, together with space allotted for carpenters and packing-case making.

FIG. 3.—BRASS FOUNDRY.—J. HOPKINSON & CO., LTD., HUDDERSFIELD.

The warehouse and shipping department is 160 ft. long by 40 ft. span, with middle and top galleries, and has a floor area of 20,000 sq. ft. It provides accommodation for a large stock of all types of valves and boiler mountings, and is provided with electric lift and tramways for rapid shipment. The drawing office, too, is a spacious and well-lighted building in the main corridor. Immediately above is the printing room—where blue

prints of drawings are taken by means of the arc light for the workshops, stationery stores, and designing departments—and lecture rooms for instruction to the staff in the working of high-pressure boilers and steam plant. The works offices are at the end of the drawing office, and are in close touch with the chief draughtsman and the works manager, and in such a position that they can overlook all the main shops. The general offices comprise all the important

FIG. 4.—MACHINE SHOP, IRON AND STEEL SIDE. DRILLING BAY F.—J. HOPKINSON & CO., LTD., HUDDERSFIELD.

departments, both commercial and technical. The general arrangement is a large hall, overlooking which are the directors' offices, and also adjacent are the secretarial and board rooms and patents library, etc. The arrangement has been designed to facilitate easy intercommunication between the different departments with the least possible trouble. All departments throughout the factory are connected by telephone. Mr. Charles Clarkson, M.I.M.E., is the Engineer of the Company.

The administration block contains spacious staff and private dining rooms, where the heads of various departments meet together daily at luncheon. In order to encourage enterprise, prizes are given to workmen offering suggestions on all kinds of improvements appertaining to the business. A large number of the employés ride to and from their work on bicycles. A house with suitable racks is provided, and the machines are taken care of whilst the men are at work in the factory. With the object of encouraging cleanliness, there are distributed up and down the shops wire baskets, at various points, as receptacles for waste paper, etc., and each man is provided with a rack for putting his work on instead of its being thrown about the floor.

The factory hours are arranged on the one-break system. The hours of working commence at 7.30 a.m., workmen partaking of their breakfasts either at home or in the factory mess rooms, before starting, the only stoppage during the day being from 12.30 to 1.30. The working week is 52½ hours, and wages are based

on a 54-hour week. A bonus of 1½ hours' wage is given to all workmen who make a full week.

——o——

SIDE-BLOWN CONVERTERS.

An interesting little brochure has recently been written by Mons. Toussaint Levoz, late of the Aciéries des Forges de Stenay, and published by the Société des Publications Scientifiques et Industrielles, 26, Rue Brunel, Paris, dealing with facts relating to the practical use of Bessemer converters with side blast. We append the following abstract:—

During the period that has elapsed since the introduction of side-blown converters, so many theories on the method of their employment have been launched that it is quite time they were exploded and the proper system elucidated. Quite recently, so-called modern converters have been introduced to work with engines of 25 to 30 h.p.; but this is really no novelty, a similar small plant having been in use when the side-blown converter was first employed.

The first installation on the Continent was at the Stenay Works in 1884, with a Clapp-Griffith plant; but the results were unsatisfactory owing to the insufficient strength of the belt-driven compressor. However, on replacing the belt by pinions, ten or a dozen blows, 30 cwts. to the charge, were done in a day. The removal of the slag, as formed, gave a better grade of metal, with 25 to 30 per cent. elongation and a breaking strength of 49,780 to 46,900 lbs. per square inch. This plant was afterwards replaced by a Walrand-Delattre converter, which gave a metal with 30 to 35 per cent. elongation and 42,670 to 49,780 lbs. breaking strength, and of good rolling quality. The metal, however, did not produce good castings, these being porous and weighing much less than they ought to have done. An improvement in this respect was effected after a visit to some German steel works, semi-mild metal being produced, but the rate of production could not be increased beyond 10 to

FIG. 5.—STORING THE PRODUCT.—J. HOPKINSON & CO., LTD., HUDDERSFIELD.

12 blows per diem, until one day, by accident, only about half the usual charge was run into the converter from the cupola, the first stage of the process being thereupon found to take only 4 minutes instead of 10 to 15, and the blow was completed in 14 minutes with a blast pressure of 5.8 in. of mercury gauge. This difference, which gave a more satisfactory metal than before, was traced to the air having been blown in at a higher level than heretofore—in fact, quite near to the surface of the bath; and this was the origin of the side-blown converter.

Under these conditions the production of steel became more regular and easy, and the charges employed consisted of:—Ridsdale I., 770 lbs.; Ridsdale III., 660 lbs.; scrap, 132 lbs.; total, 1,562 lbs. The first stage was complete in 3 to 4 minutes, and decarburation in 4 to 6 minutes, the waste was reduced to 15 per cent., and the metal was so hot that it could be transferred from the large ladle to small ones for casting, and as many as 25 blows could be got through in 12 hours. The lining of the converter also lasted better, only needing repair once a week and renewing every two or three months. In working with a reduced charge it was found necessary to avoid going to extremes, an insufficient depth of metal above the tuyeres leading to undue prolongation of surface oxidation, the formation of a very liquid slag, and a tendency for the whole charge to be blown out of the converter just before the completion of the operation—unless the apparatus were tilted to increase the depth of the bath above the tuyeres—owing to the formation of an excess of iron oxide at the surface and its reaction on the carbon in the lower strata. The metal obtained by this process gave 35 to 40 per cent. of elongation and a breaking strength of 42,670 to 49,780 lbs.; it welded like Swedish iron and was used for hand-made nails. Advances were also made in casting, including piston rods, and pistons for steam hammers, engine shafts and pinions, all free from bubbles and stronger than forgings. Rolled bars of this metal gave 20 to 30 per cent. of elongation and a breaking strength of 64,000 to 78,230 lbs.

A trial was made with the Robert rectangular converter, but the lining burned out in nine blows, and the apparatus was discarded as impracticable. The Walrand-Delattre converter was resumed, and at first worked with a still smaller charge than before—770 lbs. of Ridsdale I., and 440 lbs. of Ridsdale III., or 1,210 lbs. in all; but towards the middle of the week, the capacity of the converter having increased, the charge was increased to 880 lbs. of Ridsdale I., 440 of Ridsdale III., and 110 of scrap, 1,430 lbs. in all. A few days later the charge was raised to 28 cwts., and castings as large as 22 cwts. were made, the metal for which gave 22 per cent. of elongation and a breaking strength of 86,760 lbs. The waste was reduced to 10 per cent. on the average, and with a single converter of 10 to 14 cwts. capacity the daily output of ingots, 4 in. square and 40 in. long, was 10 tons, or 250 tons a month, with 1 to 2 tons of castings per day, or 30 to 35 tons per month, at a cost of 72s. per ton. The total cost of the plant (most of which was bought second-hand), including a 30 h.p. engine for the blower, was £536. It would be difficult at the present time to find a side-blown converter costing so little and furnishing metal hot enough to be transferred twice on its way to the casting pits, and poured through a 1-in. nozzle.

For a time attempts were made at the Stenay Works to use a modified form of Robert converter, of D-shaped horizontal section, but this would not give the extra mild metal necessary for rolling. Then the Walrand-Delattre converter was lined with basic material for working with Longwy pig, and good results were obtained with 4 in. of metal above the tuyeres and 8 in. below, the metal being equal to ordinary basic steel, though much hotter, and more malleable than the extra mild metal from the acid process. The composition was:—C, 0.07; Mn, 0.30; P, 0.02; Si, 0.01. The metal was suitable for the same special purposes as ingot iron, and had the manufacture been continued it is probable that preference would now be given to small-converter steel over basic steel.

The makers of the Walrand-Delattre and Robert converters amalgamated, but the Stenay Works abandoned the former plant in favour of the latter, of which two sets, one with a basic lining for producing ingot steel, and the other with an acid lining for castings, were installed. The Company also granted licences to a Paris firm of brassfounders who were going in for steelmaking and were the first to use Fontenay sand for moulds. At this works the following charges were used and results obtained:—

Charge.	Lbs.	Result.	Lbs.
Ridsdale I. ...	3,520	Good castings ...	3,872
Ridsdale III. ...	3,300	Scrap	983½
Scrap	793	Ingots	836
Ferro-manganese	191½	Waste (runners)	1,117½
Ferro-silicon ...	108½		
	7,907		6,809

The large proportion of scrap was due to the inexperience of the men in working with metal much hotter than copper, and to the large number of small castings (averaging 6 lbs. in weight).

The Stenay Works had to close down for a time, but were restarted under more favourable conditions, and secured a large order for flat basic steel bars for rifle fittings, which metal, though less malleable than that from the Walrand-Delattre converter, gave the following results:—One bar tested in the naval shops stood 106 blows of a 40-lb. weight falling from a height of 80 in. The tensile tests gave the following results:—Breaking strain, 64,000 lbs. per square inch; elongation, 15 per cent. The composition of the metal was:—C, 0.31; Mn, 0.80; Si, 0.182. It is worthy of note that metal with this composition will not temper when made in a side-blown converter.

The small progress made of late years in the production of steel in small converters is due to the circumstance that the method has had to be taught at each works in which a plant has been erected. So far as moulding is concerned, the employment of Fontenay sand marked a distinct advance, and at about the same time the practice of casting steel at a running temperature of over 1,700 C., in undried moulds, was initiated, as well as that of re-welding with molten steel.

In the autumn of 1889, a set of small converter plant was erected at the foundry of Messrs. Vanzetti, Sagramoto & Company, Milan, under the superintendence of the author, and proved very successful for the production of railway grease boxes, wagon fittings, engine parts, shearing machine frames, pistons for marine engines, gun mounts, dynamo frames, and other electrical machinery. In wagon fittings, 400 to 500 pieces could be cast every two days, with not more than 5 per cent. of waste, and pieces of half a pound to six tons were produced without difficulty with two 1-ton converters. Fine tool steel was produced with the aid of aluminium, as well as special steels, with nickel, uranium, copper, etc. At the Milan Works the first application of electric welding was made in the repairing of castings damaged by sand. Another speciality was the production of cylinders and tramway wheels in hardened cast-iron by mixing molten hematite pig with molten steel from the converter. The use of the small converter also rendered unnecessary the employment of aluminium to prevent bubbles; and there is no danger of the castings shrinking or cracking while hot, as occurs when aluminium is used.

After Milan, the small converter was adopted in Germany, England, Spain, America, and Russia. It was then that the converter with a double row of tuyeres was introduced in opposition to the Robert converter, the idea being to arrange the tuyeres so as to prevent the gyratory motion of the metal, and, by blowing air over the surface of the bath, to prevent the ebullition which caused the slag and metal to mix. The defects of this apparatus have been already pointed out. About the same time the manager of the Charleroi Steel Works introduced a converter in which the tuyeres were arranged in the shape of a fan; and one of these converters was set up at the Monthermé-Laval-Dieu Works, but was abandoned before completion.

Having observed irregular wear of the converter lining to result from the employment of tuyeres with conical nozzles, the author in 1894 designed a converter with a cylindrical crucible and with cylindrical-nozzle tuyeres arranged in a very small arc of a circle, and on one side only, in order to reduce the zone of action of the air blast, whilst increasing its directive action in producing the gyratory motion. The wear of the lining became more regular. The iron oxide was better distributed throughout the bath, and utilised as a fining agent. The lining had a total life of 858 charges, and was then taken out and replaced, the bricks having become so scorified that difficulties in heating the converter were encountered. This is the type of converter that has been adopted by all steel-founders who have started within the last five years. The most frequent defect is the practice of blowing in the air at the surface of the bath, for fear of choking the tuyeres.

The improved cylindrical form of converter with the special arrangement of the tuyeres is recommended, and can be made in all sizes from ½ to 5 tons. An experience of 20 years has shown the absence of any need for heating the additions to the charge. The 2½-ton converter can be operated by hydraulic or electric power, and produces metal of such a temperature that the whole charge can be run into 20 ladles holding about 1¼ cwts. each, though, as a rule, two or three large castings are poured first, and the rest of the metal is drawn off into small ladles.

The fact is that users of this type of converter have lost sight of its original

aims, and gone in for large work which would have been better left to the Siemens-Martin type of furnace, neglecting quality in the attempt to produce a large output. The result of this is that expensive plant has had to be put down to repair the castings—a proceeding never required in the early days of the small converter.

The small cylindrical side-blown converter can be used to advantage in any works, large or small; and any founder turning out about 30 tons of small castings a month could produce steel for an outlay of £400 to £600, the castings being, too, of better quality than those produced in ordinary large works. The 1- to 5-ton converters are better suitable for large works, in which arrangements can be made to minimise handling. The basic iron produced in the small side-blown converter would be valuable to users of expensive Swedish iron. A small plant of three basic converters, turning out 30 tons per twelve hours' day would not cost more than about £4,000; and in small rolling mills the exact quantity of each class of metal required could be produced at home with greater satisfaction than when ingots and blooms have to be purchased from large steel works.

Though the small converter cannot compete in cheapness with steel makers producing at the blast furnace, the quality of the product is high, being at least equal to the best open-hearth steel, and cheaper than that from a 5- or 10-ton basic Martin furnace.

——o——

PATTERN FOR LOCOMOTIVE WHEEL CENTRE.

By W. P.

One of the many, and we might say expensive, jobs that have been annexed by the steel moulder is the locomotive wheel centre; these were, and in a few instances are still, made of wrought iron, and although by the use of certain methods the cost is kept down very low considering the amount of work involved, the cost of manufacturing these wrought iron centres is much higher than the cost of making them of cast steel, especially so as regards the ones that are arranged to receive the crank or coupling rod pins. The difference between a plain centre and one with the pin arrangement is shown on Fig. 1, dotted lines show the boss for pins.

Patterns for these centres may be made in various ways, such as a complete solid pattern; complete pattern, but in halves, from either of which iron patterns may be made if desired, or a mould for an iron pattern can be made from two complete arms with a portion of rim and boss attached. Each method has its merits;

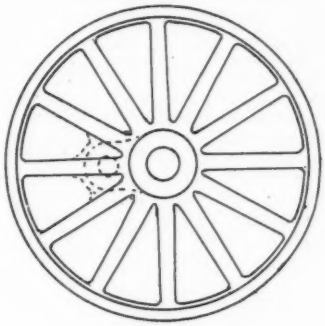


Fig. 1.

the former is more likely to be correct, the latter is certainly cheaper. Again, the former may be used in the first instance should time not permit of an iron pattern being got ready. The wood pattern is quite good enough for at least 50 castings.

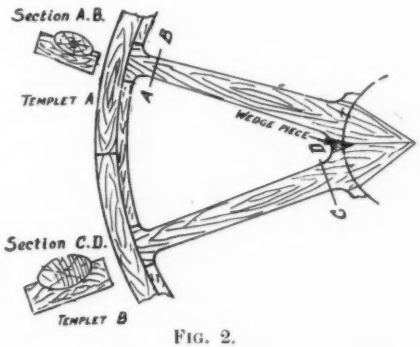


Fig. 2.

Where the wheels are moulded on a machine, the pattern can be made in halves and fastened on the plate; it will then be good enough for 150 castings. Of course, these quantities will vary according to the treatment the pattern receives at the hands of the moulder. However, no hard and fast rule can be made as regards the best way of making these patterns; the only thing certain is that

each method must be considered on its merits in relation to the circumstances under which it is required.

We will suppose that it is decided to make a full pattern. The following description of making the same is found by the author to give very satisfactory results:—

First obtain a lathe face plate, at least 4 in. larger in diameter than the required pattern, and after trueing up the plate in the lathe, proceed to build on it layers of segments, each layer about ¾ in. thick, the last, which will also be the top when being moulded, preferably of some hard wood. The whole is then turned up in the lathe to the required section of rim, leaving sufficient on the back face for trueing up when reversed. To ensure the rim running true again when it is reversed, a number of pieces ½ in. thick are screwed at intervals round the face plate just leaving enough stuff to turn up inside to the diameter of the outside of the rim. It is also advisable to again true up the surface of the face plate, as it may possibly have sprung a little during the previous operation. The rim pattern is then screwed on again and finished, it is then taken off the face plate, the inside carefully divided and recessed to receive the ends of the arms as shown in Figs. 2 and 3. These recesses are made wide enough to take in the hollows at each side of the arm.

The preparation for the arms or spokes is the next job. Good dry lumber only should be used for these, and if the material of required thickness is not thoroughly sound and dry, it will be better to get them cut from first quality of 3-in. pine deals, and make up the extra thickness by fitting wedge-shaped pieces between each spoke, as shown in Fig. 2.

The pattern-maker who can see a little further than his nose will have this lumber cut before commencing to build the rim, thus allowing it to set itself to some extent before being used, as no matter how dry it appears to be, timber invariably gives a little after being sawn.

Fig. 2 shows how these spokes are joined together. The face plate already used may now serve the purpose for building them on. Divide the outside circle into as many sections as the number of spokes required, each spoke is jointed together in the centre and temporarily screwed as they require to be taken to pieces again for band sawing to the shape.

A circle is now scribed round the end of the spokes corresponding to a diameter large enough to allow for them to be let into the recesses which are cut in the rim, as shown in Figs. 2 and 3.

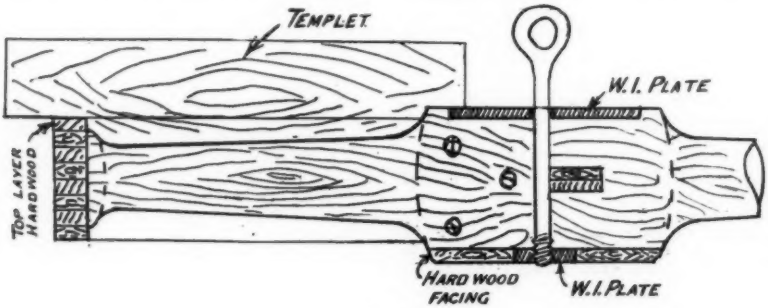


FIG. 3.

This circle is then carefully divided, the ends of the spokes made to fit into the recess as previously mentioned. These should be a good fit, and care must also be taken to have them the right diameter, for if too long or too short the rim will be distorted when screwed up.

When the whole wheel is put together, see that the rim is not twisted, and then scribe lines on the ends of each spoke by which to set them when being put together again.

A templet is now made, as shown in Fig. 3, to mark off the sides of spokes. The top and bottom pieces off one can be saved and used as a templet for marking the arms the opposite way. The wheel is taken to pieces, the spokes cut at the band saw, then put together again, glueing and screwing permanently. Templets as shown at A and B (Fig. 2) are used to work the spokes to the required shape.

The boss is made shallow enough to allow for a facing of hard wood about

¾ in. thick; this, when glued on, and with a screw through it into each arm, makes a good binder. A wrought iron plate ½ in. thick and 2 in. less in diameter than the boss, is let into the opposite face; this also answers for a rapping plate. For lifting purposes a hole is bored through the centre of the plate and boss, an eye bolt passes through these and screws into a small plate let into the hard wood facing on the under side.

There is another way in which these spokes can be secured in the centre, and that is by making a wood disc of a suitable thickness depending on the size of wheel, and grooving the spokes to fit, as shown on the right-hand side in Fig. 3. The disc is made in two thicknesses in order to have the grain crossed. If it is desired to have the pattern made in two halves, the method already described, with the exception of a few obvious modifications, will apply.

——o——

HYDRAULIC MOULDING MACHINE FOR MOULDING LOOSE UNPARTED PATTERNS.

In most foundries pattern plates are used; that is, the patterns are fixed on plates or they are cast together in one piece. The construction of these plates is a very costly proceeding, and, further, they take a long time to make, as the work cannot be done by the moulder, but special expert men are required for this. Further, the exchange of the patterns on the plate is impossible, or, at least, a very tedious and troublesome job. This is the reason why, in many foundries, casting a lot of small parts, also in malleable foundries and in foundries where keys and locks are made, machine moulding has been little introduced owing to the great variety of castings required daily and the frequency with which the patterns on the machine would be required to be changed. To overcome this difficulty, and also to allow for the moulder to be able to arrange the patterns himself, the machine illustrated herewith has been introduced.

The workman rams the box up with sand and knocks the patterns, which consist of one piece, up to the parting line into the sand. This box is used as a pattern plate, and is put on the machine which is specially constructed for this work. On the moulding box, which is acting as a pattern plate, another moulding box is placed, filled with sand and rammed, and in order to prevent the two sand surfaces sticking together the parting surface should be slightly covered with coal dust. After ramming the top box, the two boxes are clamped together by means of wooden or iron plates and then turned over, which will bring the lower box on top and *vice versâ*, and by lowering the ram the top box will remain on the top of the studs H. The patterns which formerly were in the top box will now, on account of the turning over and through their own weight, rest in the bottom box. After the top box has been taken off the studs the bottom box is used as a pattern plate, and on this another box is placed, filled with sand, and rammed and turned over in the same manner, and the top box taken off and placed on the box already on the floor. In this way bottom and top boxes are made alternately, the pattern going from one box to the other.

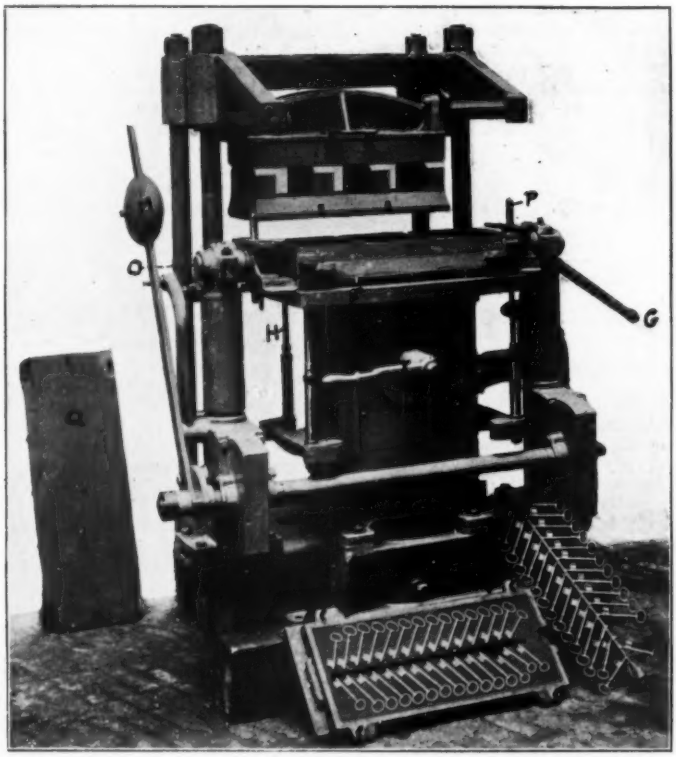
We now give a few particulars in regard to the construction of the machine. The machine consists of a foundation plate A, and the top part, B, supported by the four pillars, C. On the foundation plate the cylinder E is fixed in such a way that the ram moves with the plate F, and the raising and lowering of this is regulated by the valve G on the right. On the cylinder a cross-piece is fitted, in which the four studs H are screwed. Further on the cylinder a lever I is fitted, which prevents the press plate F from sinking through its own weight should there be a leakage. On the foundation plate A two brackets are fixed in which are fitted flat-threaded screws, the latter being moved up and down by two tooth wheels, and moved by lever M. The spindles have encased bearings N, and inside are the trunnions O. The latter have each two studs P fitted to them for taking the upper and lower press boards Q, which are fixed in position by wedges.

The working of the machine is as follows:—On the trunnion O is placed a plate or board Q, then the ram is raised sufficiently for the plate F to touch the board Q. The ram is stopped by turning the lever I 90 degrees. On the plate Q a moulding box is placed which is then rammed up by hand, and the patterns knocked in up to the parting line. The top box is now placed on, filled with sand, and rammed by hydraulic power. After ramming, the press plate F sinks down until it is stopped by the lever I. On the top of the box which has just been rammed a board is placed, and

wedged tight. Then the top half boxes, which are now clamped together, are raised by pulling over the lever M. They are turned over and lowered, so that the bottom box is now on top and *vice versâ*. The wedges are removed and lever I is turned to its original position. The ram is now lowered, taking with it the press plate F and the two moulding boxes until the top box is stopped by the studs H, the bottom box, in which the patterns are resting, following the movement of the ram. The box on top of the studs is taken off, and the operation gone through until sufficient articles of the one pattern are made.

The peculiar arrangement of the studs is noteworthy. They do not make a square but a trapezium, as can be seen from the photo. The lugs on the moulding box are arranged the same way, so that when the box is on the top it just fits the four studs, but when turned over will not fit same but passes through.

The size of the moulding boxes on the machine shown is 26 in. by 10 in., and one moulder will be able to turn out ten complete boxes per hour, under ordinary working conditions.



The London Emery Works Company, of Park, Tottenham, are the makers of the machine.

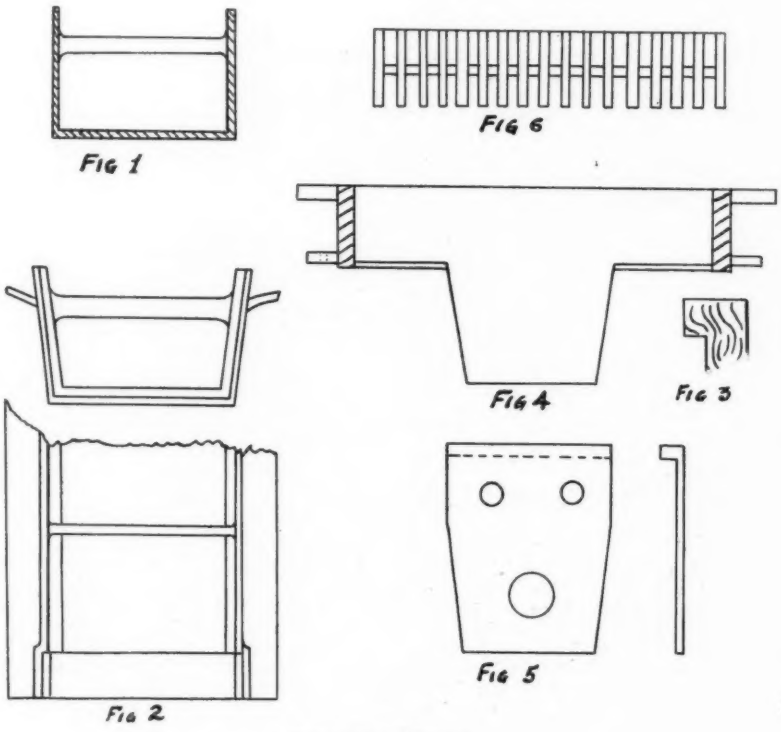
——o——

Mr. D. Dow, Junr., of the Basin Foundry, Kirkintilloch, near Glasgow, has been elected a member of the local School Board, as also has Mr. J. Cameron, of Cameron & Robertson, Limited, South Bank Iron Works, Kirkintilloch.

MOULDING GUTTERS.

By R. D. W.

While working in a foundry a short time ago an order came to hand for a number of gutters similar in section to Fig. 1. They were about 9 in. deep, 1 ft. wide, and 10 ft. long, a larger size being 16 in. deep, 19 in. wide, and 18 ft. long. The patterns were made to mould with the bottom side of the gutter to the top, battens being put in to act as stiffeners and core prints where the stretchers were cast on, cores being inserted in these prints after the pattern was drawn and the space filled up level with sand. The first two or three came out fairly straight, after which the edges of the pattern warped, the consequence being that the castings could not possibly be made straight on the top edges. They could not be properly finished, and sometimes they scabbed badly. The moulders could not satisfy the management, and the firm could not suit their customers, and in the face of this position the heads would not be persuaded to alter the method of moulding, but struggled on through the contracts as best they could, with a loss of prestige and amidst general dissatisfaction.



Moulding Gutters.

The method about to be described was the suggested alternative, and is used by many founders; it is quick, cheap, and one whereby all parts can be properly finished (for even gutters require finishing), thus ensuring a better casting and tending to give general satisfaction. Fig. 2 is an end view and plan of a common type of gutter, made in various lengths up to about 20 ft. For the purpose of moulding we require a pattern block the shape of the inside

of the gutter. This can be made of 1 in. or 1¼ in. boards screwed together and planed on the outside, sufficient camber being given to allow the casting to straighten itself in cooling. The pattern, consisting of sides and bottom, is now made, also loose pieces for the flanges and stretchers, or stiffeners, also a strickle (Fig. 3) to strike a bed for the flanges to lie on, together with distance pieces to set the stiffeners down to their correct positions.

The bottom half of the box part required is of the usual kind, and calls for no detailed description. The top part—if one has to be made—can be made as shown in section in Fig. 4, or of the frame type, the bars being made loose and fitted into slots cast in the box sides. Should a straight barred box part be handy, aprons, as shown in Fig. 5, can be cast in open sand and hung on the bars, a chock being placed in the centre of each to make all quite safe.

To mould, set two straight iron bars in the bottom box part, one at each end, just beyond the pattern and the correct distance down. If these be set on solid packing they need not be disturbed, but can be used time after time. The bottom can now be rammed up with floor sand, finishing with facing sand, and strickled off with a lath to the same camber as the pattern block. The pattern is now placed on with the block inside, weighted down, and the outside rammed up to the height of the flanges when the strickle is brought into operation, the flanges set and the ramming continued, finger grates, as shown in Fig. 6, are placed over the flanges and the ramming finished. The joint is now made and the pattern block taken out, parting sand sprinkled on, a layer of sand placed in the bottom of the gutter, and the top box lifted on. A few short lifters are all that are required, with the bars made as shown. The top is now rammed up in the usual way, care being taken to place the stiffening pieces in their proper positions, to insert runners to the bottom of the mould and place risers on the edge of the pattern. The top is now vented and lifted off on to horses, turned over, and finished in the usual manner, blacking being applied close to the runners. These castings being rather thin, there is not much need for them to be blacked all over.

Every part of the mould can now be reached, made solid, and properly finished off. Given suitable metal, the castings should be true to pattern, sound, a credit to the moulders, and to the firm.

LARGE STEEL CASTINGS.

FURTHER particulars of the large stern frame steel castings for the new Cunarders are given by Mr. Thomas Putnam in "Syren and Shipping." Mr. Putnam being managing director of the Darlington Forge Company, who made the castings. Mr. Putnam writes as follows:—

The demand for specially treated steel castings, large as it is, will grow steadily in the future. The horizon of their application is unlimited. Already they have displaced with great advantage, both economical and constructive, other materials previously used in important engineering schemes, and their advent into the field of armour and armament has finally passed the problematical stage. An illustration of the great advance made during the past ten years is that of the stern castings of the first-class mail boat "Arabia," of 8,000 tons displacement, built in 1895, when compared with those of the Cunard turbine leviathans of 30,000 tons displacement each, now being built at Clydebank and Wallsend. The "Arabia's" stern frame and rudder, weighing respectively 22 and 11 tons, were each cast in two pieces, as shown in the illustration, and were interesting specimens of the steel-maker's art of that day. The castings for the two Cunarders are a great advance, being the heaviest and most complicated castings of this type hitherto made in these record-beating times. The stern frame, a massive casting 41 ft. over all by 42 ft. high and 10 ft. 6 in. wide at the upper platform, is built up in five sections, consisting of the main casting, 47½ tons in weight; two after brackets, 47 tons; bridge casting, 4 tons; and the sternpiece casting, 6 tons; making 104½ tons in all when completely finished. The forward brackets weigh 48 tons, whilst the rudder, of the balance type, consisting of four pieces, weighs 70 tons, the rudderhead being 25½ in. diameter, whilst the pintle, weighing 1¼ tons, is 19 in. diameter. The total weight of stern frame, rudder and brackets for each ship is 223¾ tons. The intricate design, vast size, and important part these castings have ultimately to fulfil necessitated all those precautions being taken that skill and experience could suggest, both before commencing and during the course of their manufacture.

The quality of the material may be judged by the following details of one of the tests taken from the stern frame:—

Ultimate stress, 32.7 tons per square inch of original area.

Elastic limit, 19.8 tons per square inch of original area.

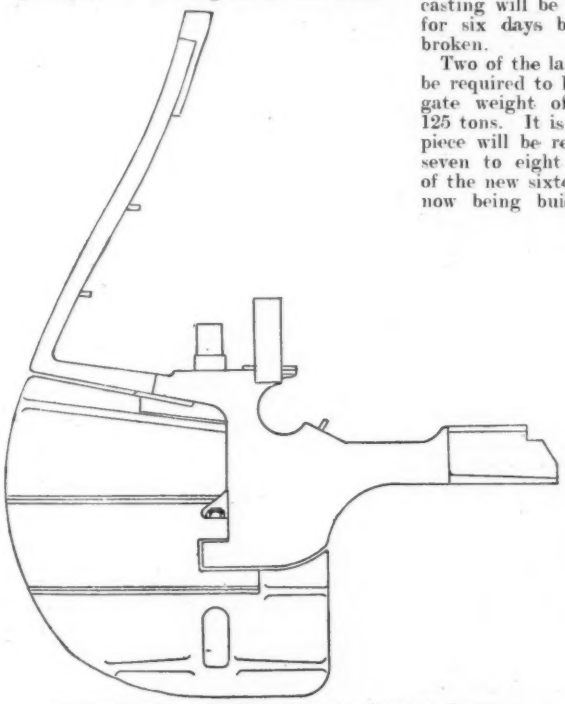
Extension in 8 in., 25 per cent.

Bend test, 1¼ in. bar 12 in. long, bent cold over a radius of 1½ in. to an angle of 180 degrees without fracture.

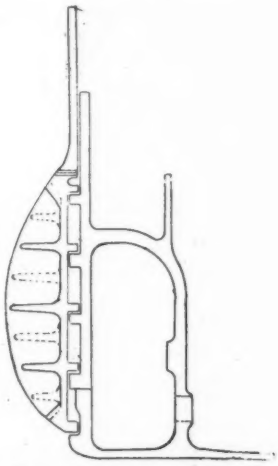
——o——

Patterns for what will be the heaviest single casting ever poured at the works of the Allis-Chalmers Company, Milwaukee, were completed recently in the pattern shops of the West Allis Works. The casting in question is designed for the frame and slide of a large horizontal rolling mill engine being built for the Carnegie Steel Company, Sharon, Pa., whose cylinders will be 50 and 78 in. diameter with a 60-in. stroke. The pattern for this piece, measuring 2 ft. long, 11 ft. wide, and 10 ft. high, represents the work of ten expert pattern-makers for a period of four months. The amount of lumber of various sizes used in its making aggregated 22,000 ft. The pattern was taken from the pattern shop directly to the foundry where work has begun on the construction of the mould. The pit in which the piece will be poured is 40 ft. long, 15 ft. wide, and 11 ft. deep. The mould, when completed and ready to receive the molten metal, will take approximately 133 tons of iron; the actual operation of pouring will consume from eight to ten minutes. Nine ladles will be used to convey the liquid metal to the mould, four of which will each be of 5 tons capacity, four of 25 tons, and one of 13 tons. After the metal is poured, the casting will be allowed to stand and cool for six days before the mould will be broken.

Two of the largest travelling cranes will be required to lift the casting, the aggregate weight of which will approximate 125 tons. It is expected that the finished piece will be ready for shipment in from seven to eight months' time, when one of the new sixteen-wheel 100-ton flat cars, now being built for the Allis-Chalmers Company, at the West Milwaukee shops of the Chicago, Milwaukee and St. Paul Railway, will convey the piece to Sharon, its final destination.



STERN-FRAME AND RUDDER, FOR CUNARD LINER "MAURITANIA."
Weight, 124 tons 16 cwt. 2 qrs.



STERN-FRAME AND RUDDER, P. AND O. LINER "ARABIA."
Weight, 33 tons 13 cwt. 3 qrs.

——o——

MR. JOHN PLUMMER, who is retiring from the position of assistant inspector of mines in the South Durham and Cleveland district, has been the recipient of a presentation from the colliery officials of the district.

THE ESTIMATION OF COSTS.*

By A. W. Farnsworth.

The increased severity of competition in the engineering trades has automatically compelled the attention of manufacturers to be directed most seriously to their estimating departments, and of late much has been printed and said on the matter by both interested and outside parties. For every job in the market there are now several—in some cases dozens—competitors, any one of whom is able successfully to undertake it, and the natural consequence has followed; prices have been gradually cut and cut until in many cases profits have completely vanished. But when a man or a company owns a works in which a great deal of capital has been placed, it is necessary that a turnover be secured, otherwise the dead charges alone will soon bring bankruptcy, and modern specialisation has been directed towards, on the one hand, reducing costs in the works; and towards, on the other hand, gaining a finer and truer appreciation of those costs in the office. Yet, notwithstanding all that is already known of these things by the heads of our establishments, all that has been written, and all that has been published, the quoted prices for engineering work to-day—based on the same drawings, specification, and information—stand as evidence that we have as yet barely touched the fringe of the subject, that we are still very much in the "guessing" stage, and that scientific methods of estimating remain in embryo.

To point this statement, let me refer to one or two actual jobs recently let. Without mentioning names, the various tendering firms can be indicated by the letters A, B, C, D, etc. The different estimates have no connection with each other; the jobs are widely diverse, and for different parts of the country, and are all for engineering appliances or tools:—

Firms.	1st Estimate.	2nd Estimate.	3rd Estimate.
	£	£	£
A	560	306	5,359
B	577	309	5,550
C	588	325	5,771
D	617	345	6,020
E	709	371	6,140
F	853	375	6,177
G	926	443	6,199
H	1,022	450	6,262
J	1,205	493	6,337

Of course, firm A in one estimate is not identical with firm A of another estimate. The first estimate shows a difference of nearly 115 per cent. between the lowest and highest tenderers, the second over 60 per cent., and the third nearly 20 per cent. Most mechanical engineers will remember the London County Council engines which were let last year, and for which the lowest estimate was £84,921 and the highest was £131,857—a difference of over 55 per cent. In the face of such figures it is impossible for us to say that even the majority of tenders represent fair money for the articles required; we are driven to the conclusion that the making up of the costs in most instances was purely arbitrary, and that, in sober fact, most of the figures must have been "guessed." If, in the first estimate, £560 represents a fair price for the work, what does £1,205 represent? Firm A may have been supposed to have included a profit of 10 per cent. for themselves; does this, then, mean that firm J has calmly put on a profit of something like 40 per cent.? We all know this is not so; we also know that wages and standard costs in any part of England where manufacturing can be carried on do not vary sufficiently to account in any wise for the disparity—not even when carriage is thrown in. We cannot get away from the conclusion that the men who framed the figures were far from conversant with their duties. Looking dispassionately at such results, it seems marvellous that half the firms in the country do not go bankrupt every year; either there is a special providence which watches over the estimator and prevents his underestimated figures being often successful, or else manufacturing is a huge gamble in which immense gains and losses have to be balanced every year's end. In any case, the purchaser cannot feel very comfortable in his choice of a contractor, and it is small comfort to the latter to find that his competitors value the job at a much higher rate than he does himself.

Now, the accepted theory of estimating does not leave much to be found fault with. So far as pure theory goes, all the firms which have been instanced have estimated on correct lines; it is only the putting into practice of the theory which has been wrong. Many minds have been at work endeavouring to arrive at the essentials to correct estimating, and it is pretty generally acknowledged that the first and great essential is accurate costing of the work previously done. To attain this end many schemes have been propounded, and much paper and ink used, but yet, so far, the results seem very

* Paper read before the Coventry Engineering Society.

negative. There are few firms of any standing who have not reams of figures at their disposal showing, or purporting to show, exactly what work they have for years been engaged upon has cost. Yet the absolute accuracy of those figures is generally doubted by the very men who have compiled them, and they are ever on the look out for some new infallible system or some novelty in card indexing which shall give them what they are seeking.

It is curious to the onlooker to note the different methods of the average estimator. No two men will perhaps approach any one job in the same way. Some men "lump," others minutely dissect, others, again, try the half-way house; yet all desire the same end—accuracy. Often past costs are turned up and efforts made to apply the figures found, but only those who try know how often this ends in wholesale rejection of the old figures and the substitution of empirical ones. Of course, when an article is standardised—such as a 12-in. lathe or similar tool—and prices are fixed, these remarks have not the same force. In such cases the old figures are used over and over again, and some semblance to accuracy is found; but "estimating" as a science is misapplied to multiples of the same thing; its true scope is only found when every new job differs from every old one, or when a totally new pattern of an old tool is being introduced. Generally speaking, the old style estimator looks at a drawing and endeavours to frame in his mind a picture of what he sees and to allocate the whole into a particular division or class; thus, if it be a new pattern of twist drill, he will mentally compare it with other patterns and put it in the same class as the pattern it most nearly resembles; when he has succeeded in doing this he is persuaded in his own mind that he knows exactly what it will cost, and down goes the price in a lump sum. Sometimes he is wrong, sometimes right—anyhow he has but attempted a shrewd guess, and this is not science. The new style estimator has a very different way. He produces records of the "costs" of past work, figures worked out to two or three decimal places, searches his file for verification of turning, cutting, milling, and other prices, turns up the actual cards of the several jobs and extracts lots of information—what for? To hatch new figures which will be applicable as nearly as he can tell to the new work. The different decimals are added together, and a result presumably accurate to the hundredth part of a penny is produced; the real net result being, however, only another form of guesswork. The new style is science, yes, but misapplied.

Whilst advancing these opinions the author is not seeking to condemn all estimators—far from it. There are men engaged in this work who are far above criticism, and with whom the author would not venture to dispute on points. The average methods and men only are for the moment under review, and personal and particular instances are in no case meant.

There can be small doubt that ideal estimating consists in minute dissection and gradual building up of the total price from an aggregate of properly considered minor operations. There is neither no question that accurate costs of previous work are essentials to any success. We can subscribe to this without further argument. Estimates, whether of machine tools or bridges, should be built up in very much the same way as a builder arrives at his lump sum price—from a bill of quantities, with each item carrying its allotted and proved sum. It is, however, to be hoped that while the system itself is followed the results will be more authentic than the average builder's tender. The connection between costing and estimating is most intimate—in fact, 75 per cent. of the necessity for incurring expense in costing is due to the exigencies of the estimator, and with a view to future work, the other 25 per cent. being taken up with the desire of seeing that the work does not exceed its estimate, and of checking its progress and arranging that by hook or by crook it shall come within the estimated figures. The estimator is nothing without his costs, and it follows that the prime necessity of his being is that his costs shall be reliable. How to make them so is what everyone interested in the question is trying to solve to-day. Many men pin their faith on some particular system of keeping accounts, some novel ruling of ledgers and cost books, or a certain size and configuration of a card. Now, while one certain method of keeping figures in juxtaposition may be admittedly better than some other method, it is utterly vain to expect that accuracy and reliability will ensue because of the method. Whole store-rooms full of figured papers may well result from the system, and any little part of the whole may be instantly accessible; but unless the little part when found is actually reliable, it is of small use except to look at; it is a monument to great, painstaking, and intelligent arrangement of detail, but it is useless as a fact.

Hard facts are what the estimator wants

—more or less accurate approximations are what he usually gets.

We often say that statistics may be made to show anything; that given certain figures which are actual facts, they may be so juggled and presented as to show absolutely contradictory conclusions. We know this to be so. In the same way may costs be made to show anything desired, or what is unconsciously desired, by the compiler. The human element in costing is the dominating factor; and it cannot be got rid of unless the works grind out the same article year in and year out, and costs are kept as a fad or check merely. If the work turned out is such that the constant repetition permits of the introduction of a cast-iron system, and its working entrusted to the average clerk entirely, then the human element can be largely eliminated. But if every job is different from its neighbour, then considerable skill and much initiation must be shown in the handling if the results are to be worth having. How is costing usually done? Most works start a system and entrust it to the care of a good clerk, and give him as much clerical help as is thought necessary. Then, if plenty of figures result and they are neatly and carefully kept, it is considered that a perfect system is at work, and much mutual congratulation ensues. Let it be admitted that in standard articles there is often very good ground for such congratulations; but the author is emphatically of the opinion that in miscellaneous and diverse work—general engineering—the confidence is often utterly misplaced. We all know that the root of the cost of all work lies in the time spent upon it and the way in which the standard costs are apportioned to it. Now, how is that time ascertained, and how are the departmental costs allocated? In most works the workman is invited to record the time he spends; he enters it on a card or similar medium, or he confides it to a clerk who visits him daily to learn what he has been doing. Sometimes his foreman is required to check it, sometimes not. The time given is respected as were the laws of the Medes and the Persians, and is duly entered up; by a proper system of entering, the work can be brought up to date daily, and there are works in this country whose system has been so well developed that the head cost clerk can inform his principals as to the precise position of every job going through, the amount spent, and material bought, etc., up to the end of the previous day, as shown by his books.

If a works is engaged upon miscellaneous work, everyone acquainted by experience with the life of the shops knows that the foreman will often have to give the same man several little jobs during the day. Sometimes it will happen that a fitter can spend several successive days at the same job, but oftener he will have continually to chop and change; work comes from the lathes irregularly; the shapers and planers cannot always keep pace with the lathes, or some bit of smithwork hinders or helps, as the case may be, and delivery times have to be kept. Consequently the foreman must scheme to keep everything going as smoothly as possible, and he moves his men to suit, without regard to the cast iron system of the cost clerk. It becomes difficult now to gauge exactly how time is spent; the man puts down his time to the job which he thinks will stand it best, and if a long contract is in hand it will get the doubtful benefit of much time which has never been spent upon it. For one thing, it is irksome to put time down to half a dozen different jobs which he may have handled during the day; for another, he has not scrupled to waste some time in changing, knowing how difficult of detection it is, and he "lumps" his time as he thinks well. Again, the foreman may have a very lean job on hand, and he takes care—as he can in any establishment—that it is treated tenderly, and not burdened with a good deal it might be. So that, when all the time on any job is reckoned up, it has taken so many chances of being correct, that it may be near the truth, or, as is more likely, it may be a long way off.

Then comes the apportionment of the standard costs. It is general practice to take this as a percentage on the time costs, and, though many efforts have been made to devise something better, yet the simplicity of the system, as compared with the complexity of any other way, still ensures it the first place. Staff salaries, foremen, labourers, rents, rates, taxes, depreciation, stores, coal, water, gas, lighting, and all other dead charges are added together, and found to amount to a certain percentage of the wages bill. This percentage is added to the time costs, and the results are supposed to show the actual works costs, less the material used. The supposition is more convenient than accurate. It takes absolutely no notice of the length of time different jobs are under construction; it does not differentiate in any way between the work which is quickly in and quickly out, and that which, through various reasons, is months on the way; again, it only accentuates the errors which may have

been made in the time costs, and, if a job has 25 per cent. more time down to it than it ought to have, it does but increase the mistake already made. Often it happens in a shop that a job may demand the constant presence of one or more labourers, whilst another one is hardly ever handled by them; yet the same percentage for labourers goes down on both. Again, some work may be in the shop for months, and only get one or two weeks' honest work upon it, yet the same percentage for depreciation, rent, rates, taxes, etc., etc., is put upon it as though it had only been about those one or two weeks.

In all this we have considered time or day work only; the problem gets more difficult when day work and piecework, or premium systems, are mixed in the same shop. The same arguments apply, with redoubled force. All changing time, all wasted time, everything that can be, is laid down to the day work job, with the consequence that the former gets a great deal more than its share and the latter a great deal less. The dead charges percentage is usually added regardless of the vastly different conditions under which the work is done, and the net result is bound to be chaos. If a whole shop, or a whole section, or certain tools, or certain men, can be kept wholly on piece or premium work, then the case is different, but for day work alone, or day work and piecework mixed, it is not possible to get accuracy on these lines.

The results of these systems of costing are laid before the estimating department, and comparisons instituted between the projected and the "ascertained" costs. Ideas have to be recast, and the estimating clerk has to embody what is put before him in his next estimates. Is it small wonder that different firms give vastly different prices for precisely the same work? The oddity would be if by any chance they agreed; yet the work as work is only worth so much, whether made in the North or the South of the country. True, wages differ in different places, but where there are high wages there is cheap coal or some other set-off, so that one thing balances another. Take two firms in the same district: the odds are that their estimates for the same work will vary considerably, location—provided the works are in an industrial district—not seeming to have any influence at all.

We have by now seen that the average method of costing is a pure approximation only, and that, consequently, there exists good reason for the uncertainty of the estimator and his apparent irresponsibilities. But if we understand the cause of any trouble we have already gone more than half-way towards remedying it, and we want now to form some general ideas which, with modifications for differing businesses, will be capable of wide application. It is not nearly so easy to build up as it is to pull down, and, perhaps, what is now going to be said may not find favour with many; but, if it excites criticism, then so much the better for the chances of beneficial change in the present system, for there is nothing like many opinions on a subject for properly threshing it out.

First of all, then, is it possible to obtain absolutely accurate costs of work? It may well be doubted whether it is, unless there is only one product to deal with. When a score or more different jobs are under way in a department, it is inevitable that there should result some mixing up of one with another. So much must be allowed by all reasonable men; yet the estimator asks for accuracy, and we must give him something that will be at least reliable; to do this we must reduce the chances of errors to the least possible margin, and so eliminate as far as is practicable their known sources. We want the utmost possible accuracy for the particular business in hand; how is this to be secured?

In taking a general survey of what is and what should be, it seems rather anomalous that the practice of separating the costing and estimating departments should be so prevalent. No business can obtain work unless the estimating department is reasonably run. The sales department may exert itself to its utmost, fortunes may be spent in advertising, but unless the estimates for work appeal to the buyers' pockets there will soon be no business to run. We have seen that estimation hangs on good costing, and it seems to follow naturally that the two departments should be one—the man who has the drafting of the proposed costs should also handle the actual ascertained costs. This is rank heresy in some quarters, I know; it has got to be very much the fashion nowadays to carry the old Scriptural admonition to "let not thy right hand know what thy left hand doeth," literally into a large business, and impose pains and penalties when a man in one department learns what is being done in another. But there is reason in all things. It is admittedly right to keep the junior clerk in his place, and not to entrust any man with more than he knows how to carry, but perfect understanding and collaboration in a business should

exist between the principal men in all departments if the utmost is to be got out of that business. If a man is not fit to be trusted with other information, although his own job is a responsible one, then it follows that he is not worthy of his own job, and the sooner he can be replaced the better. Some principals appear to dread their subordinate's knowing as much as they do; if every subordinate's knowledge was as extensive as his years would allow, the business would be immeasurably the gainer and not the loser.

Hence it follows that the estimator should be the prime coster. He should not be compelled to look at totals worked up in another department by any process imaginable for his information as to how things have gone. He should see the whole make-up of these totals, and by living in them and with them he will imbue the spirit of them and be able to see in what way and for what reasons items and processes may be altered or modified. It may be objected that if he controlled the prime costing he would alter items in his books and make his costs suit his estimates, and that prime costing would then be further than ever from the truth. In some cases there might be that danger, but if he was in any way fitted for the post and answered the description of the ideal estimator which we are about to discuss, one or two mistakes would give him worlds of information, and he would not fail to benefit by it. He might in instances be tempted to prove that his original figures were always right, but those instances would teach him just as much as though his employer had actually seen them and he had been well lectured upon them; his employer would still get the full benefit of them. On the other hand, if complete trust cannot be put in a man occupying such a position he should be dismissed at once and never ought to have had the post. The estimating department can do more to ruin a business than all the others put together. The whole question is whether final accuracy is not worth the slight risk of collusion mentioned.

All these considerations point to the same end—estimating is largely personal. The first-class estimator is born, not made. He must have natural gifts which fit him to exercise foresight; calculation must be his strong point. First and foremost he should be an adept in the particular business with which he is associated. This is not thought necessary in many firms. Generally, a clerk who has always worked in an office, and has shown more intelligence than his fellows, is set to work up the works costs, and his employer then puts on the margin of profit he thinks he can get. This may answer fairly well on the whole where the works are small and the employer is an engineer first and a business man afterwards, but it should not obtain in a large establishment where it is impossible for the principal personally to see and check everything. From the fact that on the correctness or otherwise of the estimate hangs the success of the firm, the man entrusted with its preparation should be the best man the firm possesses. Often in the firms who tackle big jobs—such as the pumping engines previously alluded to, or a high level bridge, as at Newcastle, or a subway, as at Blackwall—an error or misconception may mean bankruptcy. Generally, of course, such big work is not accepted without strict investigation by the heads of the firm themselves; but they are usually content to leave the smaller jobs to their employés—in fact, they have to. Yet in the twelve months the smaller jobs, through their number, will aggregate more than the single large job, and if a little is lost on each the total loss is just as serious. The estimator has the most responsible post in the firm, yet he only too often draws a superior clerk's salary.

There are engineers and engineers. Sometimes the cleverest engineer is of no use as a commercial man—he cannot bring his mind to figures of pounds, shillings, and pence. But given the engineer with a thorough shop training and a capacity for financial detail—and there are many such men—and we get the ideal man to fill the position of estimator to a large firm. He is not then dependent on the goodwill of the managers, draughtsmen, and foremen for information—his own intimate knowledge of shop work saves him hours of worry in ferreting out particulars every day. For all ordinary work he is able to estimate without constant reference to others; for special and particular work he will take pleasure in scheming and devising in conjunction with those whose duty it will be to do the work when it is obtained. In every concern engaged in engineering there is room for a man who, from the nature of his position, must weigh the engineering and commercial features of every job thoroughly. A first-class mechanic delights in the good job turned out; our commercial engineer sees first that every job will pay, and then gives as good value as is possible. Works are not carried on to delight the souls of mechanical enthusiasts, but solely because they should be dividend-paying enterprises.

Let the best available man be given this position; promote the head draughtsman, or the works manager, or the engineer—whichever is best fitted—and then give him control of the costing and estimating with power to direct operations if he sees anything going wrong. Make his position depend on his success; pay him largely on profits if you will, and the result would be that there would soon be fewer works existing for the apparent sole benefit of the staff.

What are the essentials for such a man? First-class engineering knowledge, keen business perceptions, and abundance of tact—none of them impossibilities, but qualities to be found in many men now occupying subordinate positions. Once create such posts, and there will be no lack of men to fill them. The work itself is interesting and attractive, and calls for the best in every man, and engineers would willingly fit themselves for it. The bane of our trade to-day is the workman who only knows his work, and the newer generation of college-bred men who only know their books. The employer can only see the two classes; the first is of use only as a means to an end, the second solely as a theoretical man and designer. We want badly the middle man; the man who has had a good education, and then grown up in the shops; been a journeyman, a foreman, a draughtsman, or a manager, and risen because of his merits. This man will make the best estimator and watchdog of the firm's interests because he knows.

Give such a man some good clerks and let him devise his costing system to suit the works itself— not try to introduce some patented system only because it is reported to be working well elsewhere. Mere parrot-like imitation is of no use; no two works are exactly alike, and most careful study is necessary to get the right system. The estimator should be the brains, and his clerks capable of keeping the books. It is of no use advocating this plan or that plan for any one place; there will be only one best plan, and that should be of the devising of the man who knows most about its capacities and peculiarities. As to gathering the information from the works, instead of entrusting this duty to junior clerks, who do not know a spanner from a coupling, why not take the most intelligent young mechanic in each shop or department, and let him check and verify the men's time? He should live in the shop all the time and be responsible for seeing that all time is accurately booked by the men. His own knowledge of work will prevent—if he be the right man—the wholesale misapportionment now so prevalent, and there will be at least a chance that each job gets something like its due share. It is impossible to expect a busy foreman to know each man's time on each job to an hour; he has more important duties to attend to. There is plenty of ambition amongst our young journeymen; we have only to look at the crowded technical colleges and the institutes to see this; once make positions of this nature and you give them an incentive towards fitting themselves—they can see how they may lift themselves out of the ordinary groove. It may be objected here that they would be tarred with the same brush as their fellows, and what is now chance deceit and chance errors would soon become organised and intentional. Not if the right man is in the position of estimator; he knows too much himself to be long deceived. Human nature may err occasionally, but it is very chary of doing it designedly when an almost certain Nemesis awaits. Checks and corroborations of work will readily occur to the practical man; there is no need to enlarge further here.

To be accurate, departmental expenses want careful sub-division and handling. It is not fair to put the ordinary percentage on work which requires very little labour. A great amount of discrimination and intimate knowledge of work is necessary if differentiation of any kind is to be attempted. Yet, if we are to know really which class of work is paying us best, and which we ought to cultivate or the reverse, such differentiation is necessary. We are aware in the abstract that certain classes of work absorb the dead charges heavily; do we really know whether they are giving any real return for what they take, or is the shop being kept on mainly by other classes? These things are vital to a works; but they can only be successfully solved by a man in the position of our estimator. Such a man would, given the opportunity, find the weak places and give to the firm a rational policy; many places which are now only just existing would become dividend-paying—not by any revolution in management or trade, but by the intelligent appreciation and use of hitherto unknown or neglected facts. It is impossible now to indicate details of how this would be accomplished—the details will vary with the establishment; it is the principle which just now concerns us.

We have now arrived at the point where we can consider briefly how an estimate should be made up. Undoubtedly minute dissection of the whole into its parts is the only correct way. Let us imagine our

firm is tendering for a new pattern of crane for the Admiralty, just as an example. We have here a conglomeration of engines, boiler, spur wheels and pinions, shafts, clutches, winding barrels, travelling wheels, etc., etc., and to get the total cost of the whole we must separately consider each part. New patterns have to be made throughout. Probably there will be records of the cost of patterns for other cranes previously made; if so, they will be valuable for comparison. In any case the foreman pattern-maker would be consulted as to his estimate of costs, and he should send in to the office a priced estimate for each item. This will be checked by the estimator from his own knowledge, and possibly corrected in particulars. This is where the average estimator fails. He has no knowledge of actual work, and cannot tell how long it would take a good pattern-maker to make the wheel pattern or any other pattern; consequently, in such cases, he is entirely dependent on the foreman, and with the best will in the world foremen have been known to be woefully out in their calculations. After settlement of the expected wages cost in patterns, has to be decided the cost and nature of the timber and other material to be used, and then the shop or dead charges have to be carefully apportioned. This latter is the most delicate operation for the estimator, and should be considered with a careful regard to the time to be occupied, and the other work likely to be in the shop at the same time. If overtime will have to be worked there may be the expense in running engines, lighting, extra wages, etc., the nature of the patterns may also demand the presence of pattern-makers in the foundry to some extent, and according to the work there may be numberless similar points to be watched. All these can only be efficiently gathered by a good estimator working in sympathy with the different foremen and drawing largely from his own experience. Following the pattern-making will come the moulding, and a similar routine will obtain; the foreman will give his idea of his wages costs, and this must be carefully weighed by the estimator, who has also to consider the probable dead charges and the influence of the other work in hand, the sand, coal, coke, lighting, melting, carrying, drying, fettling, and labouring, to say nothing of the qualities and prices of the iron and scrap to be used. There is a vast amount to think about in all these things, and yet it is obviously grossly unfair to take either the wages costs or the weight turned out and lump on an ever varying percentage obtained from the average of a year's working. Each particular job should stand its own expenses as nearly as scientific methods can make it, and here accurately kept costs will be of incalculable advantage.

By the time the foundry has turned out the castings the machine shop has to take them, and here again very careful work is necessary. The foreman should be taken into confidence and help in the framing of the machining costs. Every piece must be considered and labour expense detailed; the machines available and the other work in hand will want taking into account, as also the probable demand on the motive power, the time the job will be about, the handling it will take, and the attention to be given by the cranes, the space it will take up, and the labourers' time it will absorb. Every single factor entering into its composition as a job will require thinking about. Similarly in the erecting shop, and again in the testing and proving yard. Nothing can be neglected; everything must be considered, and have its place. Is this, then, work for clerks untrained in the lore of the shops? Can it be safely left to the perspicuities of the different foremen only? It demands and should have a master mind.

Until, however, we get some such safeguard, estimates will continue to vary as they do now. Whether we take an estimate for a sewing machine or a Forth Bridge, the same principles should be followed, the same care be given to every detail. Rule-of-thumb methods will no longer do in the engineering trade. Time was when profits were so large, and work so easy to obtain, that the strictest attention to detail was not necessary. Nowadays, with a keen struggle for existence which is to be seen everywhere, we must proceed on almost mathematical lines to retain our position. To the statement that such a course as has been outlined would be still further increasing the dead charges by employing highly paid labour to do that which is now done by cheap labour, the right reply is that the contrary would prove to be the case. We cannot efficiently reduce dead charges until we really know what they are, how they exist, and how they are abused. It is only highly-paid labour which can show us this. Many medium-sized works have a dead charge of £10,000 per annum to face. Let them increase the costing and estimating staff by £200 to £300 per annum, and the odds are that within a short period the remainder of the charges will have been brought down 20 per cent., because weaknesses will be shown, and the

proper remedies indicated, non-paying work will be deducted, and well-paying substituted, and the whole tone of the establishment raised. There are few works but want the knife badly in their administration: so long as it is nobody's business but a harassed principal's to do the cutting, so long will the cancer remain, for nowadays he has almost enough to do to grasp the ends of the threads without being able to trace them throughout their whole lengths. Put the right man in the position indicated, and alteration is bound soon to ensue.

——o——

ROTARY BLOWERS: THEIR CONSTRUCTION, EFFICIENCY, AND APPLICATION.*

By George C. Hicks, Junr.

I shall confine my paper to a rotary blower in which the impellers are symmetrical about two axes at right angles to each other and alike one to the other, the lobe of one passing through the throat or waist of the other. In rotary machines the pump and engine antedated the blower. In fact, the Roots blower was itself directly responsible for an attempt to build a water motor by the Roots Brothers. A foundryman standing close by noticed the current of air delivered by the machine and induced the Roots Brothers to build him one for foundry purposes. It proved a success, and was the foundation of the rotary blower of to-day, for, with one or two exceptions, the characteristics of the original Roots blower have been adopted as the best and simplest form of rotary machine to date. These characteristics are two impellers of identical form and symmetrical about two axes at right angles. The development has been very gradual, and the changes those of mechanical detail and shop convenience, and as improved machinery capable of more accurate work was placed on the market, slight changes in impeller forms have been made to take advantage of the chance to improve the efficiency by closer machine work. From a machine giving fair efficiency at a pressure of 1 lb., we now have one that at 3 and 4 lbs. shows an efficiency equal to the best design of blowing engine and at a much less cost.

General Design.

The general design of rotary blowers is much the same, different manufacturers differing mainly: first, form of impeller; second, manner of mounting impeller on shaft; third, design of bearing.

The machines are made either horizontal or vertical, a horizontal machine being one that has the inlet at the bottom and the outlet at the top or the reverse; a vertical machine, the inlet and outlet at the side. The vertical type has some advantage for connecting piping, but the horizontal machine is stiffer and capable of running at higher speeds, which give better efficiency. Either gears at one end or gears at both ends may be used. Single gears are used for pressures up to 1 lb. when used without outboard bearings, and up to 10 or 12 lbs. when supplied with double outboard bearings. Double gears are used over the entire range of pressures, and the choice is generally determined by the type and class of machine driving the blower.

Bearings for light pressures usually have only an up-and-down adjustment, but for machines from 2 lbs. up the quarter box is preferable, as strains have to be cared for that do not matter in the low pressure machines.

Self-oiling is almost universal on all styles of rotary blowers, and may be either by chain or ring. Both find their advocates, but I believe the final result will be in favour of the ring. The machines are generally made up of from 8 to 12 parts, as follows:—

The head plates carrying the bearings.

Two half circles in which the impellers revolve.

Two impellers and shafts.

Two or four gears and gear cases for same.

Two pipe plates, discharge and suction.

One bed-plate for direct connection to engine or motor.

The design of the individual parts must be such that there shall be no deflection in any part of the machine. The theory and construction both demand stiffness. The head plate must be so ribbed as not to bulge out under the pressure of the air, or give at the bearings under the shaft pressure. The half circles must also be rigid under pressure and stiff enough to resist any tendency of the head plates to spring them. As head plate clearances are as low as 0.006 and case clearances as low as 0.01, it will readily be seen that to keep a machine from pounding, the keynote of construction must be rigidity. So also the impellers, besides having a good shaft bearing at each end, must be ribbed inside, and for pressure over 1 lb. supported by a longitudinal wall running

* Paper read before the Western Gas Association.

from one shaft bearing to the other, forming virtually a box girder. This construction is absolutely necessary, for no matter how stiff the case, if the impellers themselves spring, the machine would soon give trouble. The shaft also should not give under the load.

The proper relative position of the impellers being due to the accuracy of the gear cutting and setting, great care is necessary to have the gear square on the shaft, keyed or clamped without distortion, and teeth cut so there shall be no irregularity. Two teeth should always be in contact. If more than two teeth are in contact, it means a finer pitch, which has a tendency to weaken the tooth. If less than two, there is a chance for backlash to take place. The width of face of gears on blowers is generally about three times that necessary for driving strength, and is proportioned for wear, so that the adjustment of the impeller positions shall be necessary at long intervals only.

Impeller Curves.

In taking up the subject of impeller curves, I want first to disabuse your minds of the idea that they have any necessary relation to the curves used in gear teeth. The object of the two is radically different, for gear teeth are for the purpose of transmitting power, while the last thing the blower manufacturer or owner desires to do is to transmit power from one impeller to the other.

The choice of a particular curve should be based on, first, the simplicity and accuracy with which it is laid out; second, ease of reproduction in shop; third, the amount of metal left at the waist of the impeller. The first insures accurate templets, which are absolutely necessary for good work, and the second insures accurate reproduction in the shop, for the less complex and more free from sudden changes of curvature, the easier the impeller is to machine, and consequently the greater uniformity of the clearance between the two impellers when operated. The third covers structural strength, and is subservient to the others, but is still a point to be considered in design.

The curve used for the impeller does not affect the leakage of air at either the head plates or case circle. This leaves, therefore, only the rolling together of the impellers at the centre line to be considered.

The closer the curve through the throat agrees with the curve of the end of the impeller passing through it, the less the slip, but too close a fit is liable to run on to another shoal, the danger of one impeller hammering the other.

Wear of the Gears.

Now, as to the wear of the gears; the shape of the curve governs the strain on the gear teeth, but only the driven impeller need be considered, for the impeller on the driving shaft does not affect the wear of the gears. If the moments of resistances be plotted on a circular base, it will be found that the resultant curve is an exact reproduction on a larger or smaller scale of the impeller curve itself. In jump contact impellers the curve becomes concentric for the angular movement taking place during the shift of contact from one side of the lobe to the other. In general, the resistance is inversely proportional to the distance of the centre of the shaft to the point of contact. Therefore, the jump contact impeller is easier on the gears than a continuous one; as the maximum and minimum are nearer together, but as an extra width of face of the gear will cover this advantage, the increased efficiency of the continuous contact type outweighs the gain in gear life due to the other type of curve. At low pressure the break contact type is most used, as it is cheaper to machine, and at the same time entails no appreciable loss. As stated above, an impeller having a curve that passes quickly through the waist of the other impeller answers all the gear requirements, and at the same time is of the best form to retard slip.

Slip.

The slip in a rotary blower should vary as the square root of the pressure, speed being constant; and inversely as the speed, pressure constant; directly as the clearance; directly as the square root of the reciprocal of the specific gravity; directly as the square root of the ratio of the absolute temperatures.

Taking them up in order as above stated, the effect of pressure comes first. The slip varies according to the law of flow of air through an orifice modified by a constant C. The opening between the case and impeller and the impellers themselves is long and narrow and on the ends more like a narrow passage between two flat surfaces. As the end clearance may be made very small, this cuts little figure, the principal source of loss being the clearance between the case and impellers and between the two impellers. In the jump contact type, the clearance space cut away has little effect on the slip, but

at high pressures, such as 5 lbs. (I use the term "high pressure" in a relative sense only as applied to rotary blowers), this clearance modifies the curve of slip so that the law of flow through an orifice does not apply. This can be seen in the pressure curves plotted for constant speeds. At low pressures the curve approximates closely the law, but for high pressure it is nearly a straight line. For continuous contact impellers, the law of flow through an orifice is very close to actual results.

Speed.

The passing of larger volumes in a given time decreases the per cent. of slip in inverse ratio as the revolutions per minute are increased. In addition, due probably to eddy currents set up by the rotation, the efficiency increases more rapidly than due to the speed ratio alone. Such a speed could be reached, however, where the velocity of the flow would be so rapid that wire drawing would take place, and when the efficiency curve begins to fall, but as this point is beyond the safe speed of the blower, it is correct to say the efficiency increases with the speed.

Clearance.

There is not much to be said on clearance: the slip varies directly as the square inches of opening. The clearance should, therefore, be kept down as low as consistent with safe operation. Small machines can be run on smaller clearance than large ones, but the loss in large ones is less because the proportion of volume to clearance openings increases rapidly. In fact, instead of being the ratio of the square inches of openings to the cubical contents, it is almost as the ratio of length to volume, for the different width of clearance spaces in small and large machines is very slight.

Specific gravity affects the slip directly as the square root of the reciprocal; therefore, gas at 0.5 specific gravity would give a slip 1.41 times as much as air under the same conditions. To illustrate, a machine showing 92 per cent. efficiency, with air at 3 lbs. pressure, would show 88.8 per cent. with gas at 0.5 specific gravity. The slip being 8 per cent. with air, the ratio 1.41, the result of multiplying together gives 11.2 per cent. slip, or 88.8 per cent. efficiency, as above stated.

Temperature affects the slip slightly only, as it is proportional to the square root of the ratio of the absolute temperature.

Friction.

Friction must be taken as the sum of all losses other than slip. It covers the friction of the gears, bearings, stuffing boxes, and impellers in the case. The latter in a machine in correct adjustment may be neglected. Stuffing-box friction is dependent on the condition of the packing, and may be large or small, but when properly packed it is a very small item. The friction losses, therefore, narrow down to two principal ones—the bearings and the gears.

Considering the gears first, we find that the driving gear transmits just one-half the load, the other half being applied directly to the impeller mounted on the driving shaft. A well-cut spur gear, properly lubricated, will transmit its load with a loss of between 5 and 10 per cent. Taking 8 per cent. as an average loss, we would have the gear friction equal to 4 per cent of the total load applied to the shaft Allow, say, 2 per cent. for the stuffing boxes, and we have a total of 6 per cent. Now, as the friction of the whole machine seldom exceeds 10 per cent., and is generally about 8, we have 2 per cent. left for the friction consumed by the journals. In a top discharge machine, the driving shaft at the driving end is relieved of part of its load through the reaction of the gears, while the driven shaft has this thrust added to it. The bearings, therefore, should be proportioned for the total load on that shaft. In a bottom discharge machine, the load on the driven shaft is lessened by the pressure of the fluid handled, and the load on the driving shaft is greatest as the gear reaction is down on that shaft, although it also is relieved of part of its load by the upward pressure of the gas or air. Care must be taken that the total upward pressure on the impellers does not exceed the total weight of the impellers, shafts, and gears, for a floating shaft would be hard to keep in proper alignment, as all the thrust would come on the cap. An outboard bearing on the driving end divides the thrust of the gears on a single-geared machine, and thus reduces the wear and friction. In a double-geared machine the gear thrust is taken on both ends equally, provided each set of gears is doing an equal amount of work.

Efficiency.

In order to arrive at a correct understanding of the term "efficiency" it is first necessary to fix on a standard of performance or basis on which to figure.

I shall use as a standard the horse-power actually used for any given amount of free air delivered against any definite pressure, compared with the amount of power needed theoretically for the same conditions by the formula :— Horse-power equals cubic feet displaced per minute multiplied by the pressure in pounds multiplied by 144 and divided by 33,000. This is virtually figuring the horse-power on a square card, but as the adiabatic curve affects the power but slightly at low pressures, it is not necessary to consider it. For in comparing different types of machines, the only fair method of comparison is cubic feet of free air delivered per horse-power used or applied to the shaft of the machine.

(To be continued.)

——o——

N. Hingley & Sons, Limited, Netherton Iron Works, Dudley, are making cables for the new Cunarder "Lusitania," and also the large anchors for both vessels. Messrs. Brown, Lenox & Company are the makers of the cable for the third Cunarder.

A NEW CORE-MAKING MACHINE.

By Foundry Foreman.

There are now several different types of core-making machines on the market, and the foundryman who is wanting something different to the standard types now made must have a very special class of work indeed. When we foundrymen are asked, and expected, in fact, to make castings with cored holes almost as round and straight and clean as bored holes—which with the old-fashioned wood core-box we all know is practically impossible—we are very thankful to find something which will enable us to do so with a considerable amount of satisfaction to ourselves and our employers, and that at less than half the cost for labour into the bargain.

New Core Making Machine.

I have just had a catalogue of foundry specialities put into my hands, by which I see the firm of Messrs. Horace P. Marshall & Company, of Leeds, are showing a new design of piston type core machine. As I have just tested the

capacity of one of these—size B—machines for my firm, I am able, and have permission, to give your readers the benefit of my experience. The claims given in the catalogue for the machines do not in any way exceed the actual capacity, as will be shown later, and I may also say that we have a size A machine which makes cores up to 3¼ in. diameter, and up to 12 in. long, as shown in the catalogue.

The size B machine is of rather different construction to the size A, but in principle the same, the chief difference consisting in the rack which carries the piston being actuated by a toothed quadrant and lever instead of a pinion and hand-wheel as on the A size machine, the former in my opinion being much the better method of the two, especially for the B size machine, which makes cores up to 6 in. diameter and up to 15 in. long, Cores for this size require some little pressure to start them from the core die, which by the lever arrangement and a few raps with a hide or wood mallet is very easily accomplished.

Another difference is this: a graduated sector which is marked off for inches and parts is fixed on the front of the machine close by the lever handle, and on this sector is an adjustable stop, which, when set, determines the stroke of the piston, and, therefore, the length of the core. This stop is set by a hand-screw, no spanner being required for any change, the core dies being held by simply placing in and giving a slight turn by hand which secures them under a catch.

A vent wire—which can be easily removed or renewed when found necessary—is fixed in both machines, so that all cores may be sure of a vent, and that not out at the side either; in fact, everything appears to be well thought out and also substantially constructed. I have never seen a more satisfactory machine, as any kind of core mixture may be used for either iron, steel, or brass work.

Below is a copy of my report to my firm, dated September 23, 1905:—

> "I have this day tested core machine size B with the following results, without help:—Changing core dies and adjusting length 30 to 60 seconds; making core 6 in. diameter by 15. in. long complete, 1 minute; making cores 2 in. diameter by 6 in. long, 12 per 5 minutes, or 144 per hour. I am satisfied that this machine is one of the best, if not the best, of its class, the core dies being very truly and smoothly bored."

I ought also to mention for information that cores with bosses in, or necks, or shouldered, or with other irregularities can be made as well as plain, straight, round cores, and that multiple core dies are supplied for small cores, by which arrangement a very large number of cores can be easily made up to 500 or more per hour.

A good size sand bench with edging is part of the machine. Of course, other vents and rods can be added to the cores as required.

—o—

A MODERN STEEL FOUNDRY OF THE SQUARE TYPE.

The foundry of the Baldt Steel Company, New Castle, U.S.A., is, says the "Iron Age," of special interest in being a departure from the "long drawn out" design of shop construction that has been followed in so many foundries and machine shops built in recent years. The theory of those who have advocated the "shoe-string" construction has been that it afforded advantages in its straightaway crane runways and in lending itself to the continuous progress of material from the receiving end to shipping tracks at the other end. It has been considered by many that a foundry in which large work is handled, being to such an extent a crane proposition, gets relatively more economies from the long building than would be secured by a machine shop. The disadvantage is that in a large shop, the superintendent starting from one end would have to walk, say, half a mile to give an order at the farther end.

The Baldt Steel Company evolved the plan of construction shown in the accompanying illustrations. The prime object in the adoption of the square shop was the securing of the highest efficiency per square foot of floor space, the controlling factors being light, ventilation and crane service. The decision against the long narrow shop was based on several considerations. Among these were the loss of time in moving material from one end of the plant to the other; interference with the work of the moulders by transferring sand over the same space through which castings, flasks, and metals were handled; and, what was of much importance, the difficulty of obtaining thorough supervision, because of the great distances through which the superintendents of such plants are obliged to travel during working hours in order to keep in close touch with the work. Other objections to the long type of plant were the difficulties connected with providing a separate room for machine tools and the drawbacks that core and dry ovens could

not be located so that cores and moulds could be readily placed in them and removed without unduly interfering with work in the vicinity of the ovens.

Experience had demonstrated to the satisfaction of the projectors of this plant that the distance travelled by moulds and finished castings in a long shop is greater than in the type of plant adopted. It was figured that by providing for all departments, except the power plant under one roof, the expense of conveying castings from one building to another would be saved, as well as that factor in the cost of separate buildings due to their greater length of outside walls.

The buildings are of steel framework, the panels between the columns in the line of the outside walls being filled with brickwork, containing windows extending from 5 ft. above the floor line to a few feet below the eaves. The roof is constructed of steel purlins with wooden spiking pieces and 3-in. grooved and splined yellow pine planks. The roof is braced longitudinally by a layer of $\frac{1}{2}$-in. thick common boards spiked diagonally. This type of roof construction was adopted to reduce the fire risk, and to provide the rigid bracing in every direction required by the several lines of cranes operating on parallel runways, also to avoid the expense of heavy structural longitudinal bracing which would otherwise have been required between the interior columns. Each division of the building has a wide monitor its entire length, equipped with sashes to swing horizontally for light and ventilation.

The Furnace House.

In the furnace house a window approximately 11 ft. wide extends from a few feet above the floor to the eaves, in each alternate panel. The panels between windows contain openings 16 ft. wide, extending from the floor to the roof. These are provided with Kinnear rolling doors. Each end of the furnace house contains one such opening and one window. The thorough lighting of the furnace house is thus always assured, even when all the rolling doors are closed, and in warm weather both the windows and Kinnear doors are opened, the furnace house, under such conditions, being open on all sides.

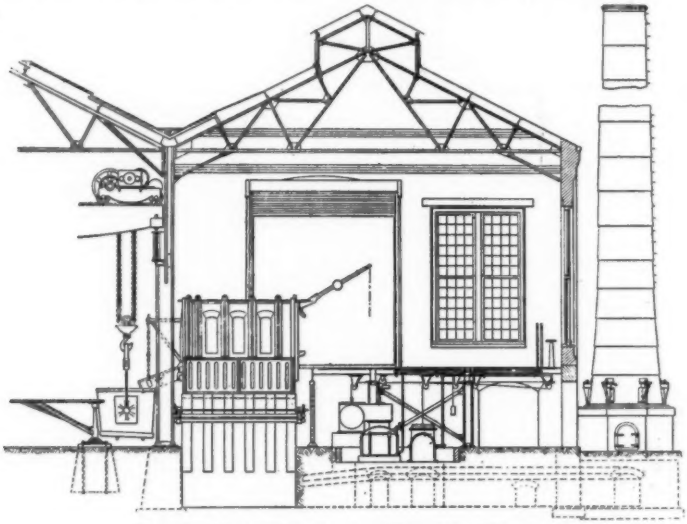


FIG. 2.—CROSS SECTION OF FURNACE HOUSE.

During driving rains the windows and Kinnear doors facing the direction from which the wind comes are closed, and those on the opposite side and end are left open.

Arrangements of Floors.

The plan view in Fig. 1, and the cross section in Fig. 2, give a clear idea of the relation of the various foundry floors, and of their equipment. The 35-ft. bay used as the flask room is commanded by a 10-ton crane. It is 340 ft. long, as is the adjacent moulding floor. As appears from the plan, the movement of flasks and material is on the most direct lines, Fig. 1

indicating how conveniently the completed moulds, after being placed on trucks, are conveyed on tracks to the drying ovens in the next bay. Dragouts are provided, so that the moulds on cars may be drawn in and out of the ovens by the use of overhead cranes. A 25-ton crane serves the moulding floor, and another crane of 30 tons capacity is being installed on this floor. The middle floor, the central portion of which is occupied with the core ovens and mould drying ovens, has the core-making department between the ovens and the machine shop. On the other side of the ovens is a space which has been used for the moulding of smaller castings, and which may be devoted later to grey iron work, particularly the moulding of flask bars. The two mould drying ovens are 65 ft. long, 20 ft. wide, and 20 ft. in the clear. A third drying oven will shortly be installed. The two core ovens, which are coal fired, are 45 ft. long, 16 ft. wide, and 12 ft. high. The oven and core-room section is commanded by a 10-ton crane.

The moulds coming from the dry ovens are placed in position for pouring with but little handling by the casting floor crane, which is of 30 tons capacity. As will be seen, the cleaning and chipping department is in the same bay. It is also equipped with a 30-ton crane. With one exception the gauge of the crane runways is the same throughout the plant, and it is thus possible to transfer cranes from one runway to another if such changes should seem desirable in the future. At the end of the cleaning and chipping department are the annealing ovens, 20 ft. by 65 ft., which are below the floor level.

The machine shop, which is virtually a projection of the oven and core-room section of the building, is 180 ft. long and 65 ft. wide, and the floor is commanded by a crane of 25 tons capacity. There are doorways in the wall dividing the machine shop from the floor on which castings are cleaned. These openings are closed with Kinnear doors for the purpose of excluding dust from the machine shop, and the doors are only opened for the purpose of delivering castings from the cleaning floor.

The gas producers and the power house are the only parts of the plant separated from the main building. Of the three 30-ton acid open-hearth furnaces for which room has been provided in the furnace house two are in operation. A third will be built in the near future. At present pig-iron and scrap are unloaded in the yard alongside the furnace house, and are conveyed to an elevator and thence to the charging floor, small cars running on a narrow gauge track being employed. Charging into the furnace is accomplished by the use of furnace peels. A complete set of tracks has been planned, and, eventually, elevated trestles will be provided for the delivery of coal and light scrap.

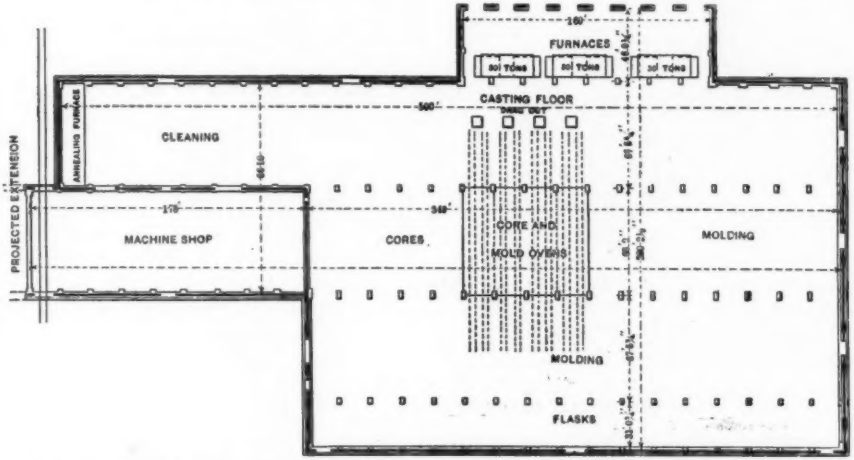


FIG. 1.—PLAN VIEW OF THE BALDT STEEL COMPANY'S FOUNDRY, NEW CASTLE, DEL.

——o——

WILLIAM SANDFORD, LIMITED, of Lithgow, N.S.W., have placed an order for four large Babcock & Wilcox boilers for their new iron works at Lithgow.

MOULDING AN AIR VESSEL IN LOAM.

THE construction of the mould for the air vessel, the elevation and section of which are shown in Figure 1, is best effected upon a car, because its transport to the stove where it is dried is very

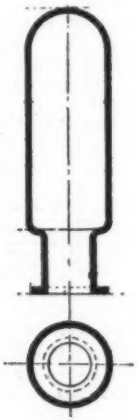


FIG. 1.

considerably facilitated by doing so. The bottom is first of all prepared upon the foundation plate A_1 (see Fig. 2). The latter is provided with a bearing F^1 screwed on to it, which serves to hold the lower extremity of the striking bar G, while the upper end passes through a

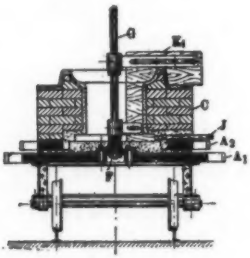


FIG. 2.

collar. This bearing G serves also at a later stage in the construction for the reception of the screw H (see Fig. 7), by means of which the core B is secured to the foundation plate A, during the operation of casting. After the layer of loam laid upon the foundation plate has dried, the plate A_2, which is in two parts, is placed upon it and the interval filled in with as stiff a loam as possible. Upon the surface of this plate A_2 a thin layer of loam is spread and the runner J through

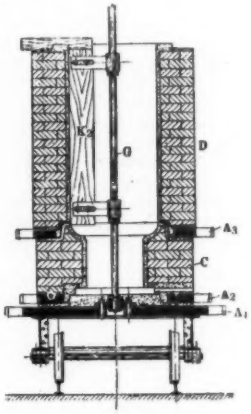


FIG. 3.

which the molten metal enters the mould is fitted in a position tangential to the flange. Before proceeding to lay the brickwork, on either side a thin sheet is placed.

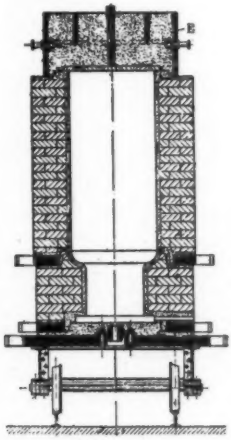


FIG. 4.

This sheet is shaped corresponding to the striking board K, which serves for moulding the neck or lower portion C of the mould. By means of these sheets the neck C is divided into two symmetrical halves. The striking board or templet K

is also in two parts, to facilitate its removal from the mould. The wooden runner J is next removed, and the whole is conveyed to the stove to be dried. After this operation is completed the plate A_3 (see Fig. 3), is placed upon the neck C of the mould, and the joint is likewise filled in with stiff loam. A layer

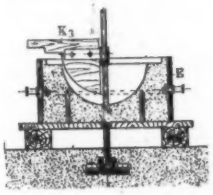


FIG. 5.

of thin loam is then spread over the plate, and the laying of the brickwork of the body of the mould is commenced. The operation of shaping the interior by means of the striking board K_2 must go on simultaneously with the laying of the courses of bricks, because, owing to the smallness of the diameter in comparison

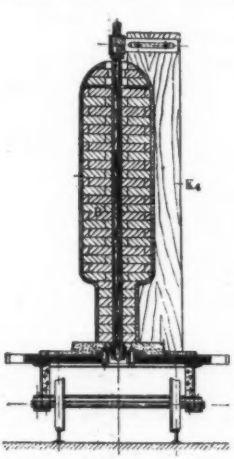


FIG. 6.

with the great height of the body, the placing of the external coat of loam after the building of the latter was completed would hardly be feasible. The car is now once more run into the stove in order to dry the body D of the mould. A wooden cover is next placed over the top of the latter and above this is put the box E^1, which is well rammed with sand. The boundary line is then scratched in the loam together with one or two other lines to facilitate the operation of fitting on the head. The box E^1 is now removed and given the semi-conical shape peculiar to the upper extremity of an air vessel by means of the striking board K_3 (see Fig. 5), in which operation the spindle or striking bar is lodged in the opening formed by the funnel or riser. After the box E has been blackened and dried, the

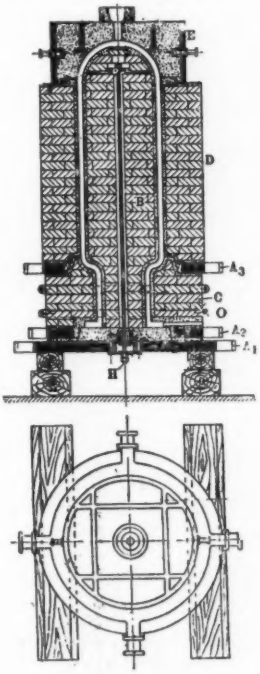
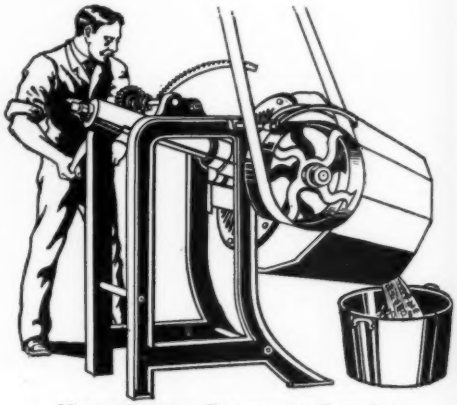


FIG. 7.

body D and the neck C of the mould are removed and blackened and dried. The construction of the core B is then taken in hand (see Fig. 6). In each course of bricks a few loam bricks are inserted in order to allow for the contraction of the air vessel after the operation of casting—approximately speaking, opposite the point where the body of the air vessel assumes a semi-conical shape. An iron plate is next placed upon the brickwork, which, however, does not project beyond the edge. This plate is provided with an opening in the centre, through which the spindle of the templet or striking bar passes, and at a later stage it serves to accommodate

the screw rod H by means of which the core is fixed. Upon this iron plate two courses of bricks are laid. In doing this care must be taken to leave in the centre enough space to allow of the insertion of a small plate or piece of flat iron to serve as a washer for the female screw of the screw rod H in order to give to the latter an adequate hold. A layer of loam about 20 mm. in thickness is now spread over the brickwork, and the shaping of the core is effected by means of the striking board K_4, which at its lower end is made so as to correspond to the base of the ing the piece. The body D is next put in position by dropping it in a vertical direction over the core. On the top of the body the box E^1 is then placed, and the now completed mould is, by the aid of a crane, lowered into the foundry pit, in which operation the suspension irons are attached to the heavy foundation plate A. After making a gate, which by means of a pipe is brought up above from the pit, the entire mould is well rammed with sand and weighted, when everything is ready for the operation of casting. In ramming care must be taken that

INJECTING WATER AND INSPECTING SAMPLES OF PARTS WHILE BARREL IS IN MOTION.



MACHINE WITH POLYGONAL CAST IRON BARREL.

THE BAIRD TUMBLING BARREL.

mould upon the foundation plate A. When this operation is over, the spindle or striking bar G is removed, and the screw H, the diameter of which is equal to that of the bearing F^1, is put in its place (see Fig. 7), and by the aid of the same the core is fixed to the foundation plate A. The space above the screw H is then built up with bricks after making the place even by means of loam. The screw H prevents the core from toppling on one side when it is being transported to the stove, and it also obviates any tendency to warp during the operation of casting. As soon as the core is dried and blackened, the two parts of the neck C of the mould are placed in position, leaving only an interval corresponding to the thickness of the casting that is to be. The joints are well-filled up, and the bands O (see Fig. 7), which are held together by means of screws, are placed round the mould for the purpose of preventing its being forced apart when cast- there is a good vent for the air in the core.

——o——

THE BAIRD TUMBLING BARREL.

THE Baird Machine Company, of Oakville, U.S.A., has designed an improved tumbling barrel of oblique tilting type, which is shown in the illustrations. As will be noted the barrel may be elevated to the position shown in Fig. 1, which it occupies while in operation, or lowered to a position below the horizontal for dumping the contents after the tumbling has been completed. As the barrel is open at its outer end the work is always in view, so that its progress may be noted, and this feature also makes possible wet tumbling, water being admitted during the operation from a pipe above the barrel opening. The barrel shaft revolves in a tilting column, power being transmitted from a small bevel gear on the pulley shaft

through the large bevel gear fastened to the fixture to which is attached the barrel. The column is pivoted, so that it will swing in a vertical plane. A curved rack is fixed at one end to the column and serves as the medium for raising and lowering the barrel, which is accomplished by means of the ratchet handle. This crank shaft is back geared two to one to assist in handling the weight of the barrel filled with work. A pawl holds the barrel in the desired position. The machine will take barrels of wood, cast iron, steel, wrought brass and cast brass from 22 to 36 in. in diameter.

—o—

FINE ART IN CASTING.

THE H. W. Caldwell & Son Company, of Chicago, have lately cast in their foundry and finished in their shops a single half of a large split band wheel. An entire band wheel was originally made by another foundry, but in putting the wheel in place on the crank-shaft of the engine, one of the halves was accidently dropped into the pit and broken. It was a planed-joint wheel, and such wheels are, of course, always cast in separate halves or sections; but it is unusual for one foundry to cast a half to match a half made by some other foundry of whose cupola mixture or practice nothing is known. The metal in the old half was analysed, a mixture figured to give the same shrinkage, the new half moulded in loam, the hub and arms cored out in the ordinary way and the metal poured, when the casting had been taken from the pit after the preliminary work of cleaning, chipping, drilling, facing, etc., had been done, the new and the old halves were bolted together and put on the 20-ft. boring mill. The face was then finished and the wheel arranged for the boring of the hub.

The diameter of the wheel is 18 ft., the face 42 in., the bore 15 in., and the weight 27,806 lbs. The remarkable part of the whole process, and that which shows the work to have been exceedingly well done, is that the finished wheel was found to be only 94 lbs. out of balance, the new half being the lighter of the two.

—o—

THE ALLIANCE WORKS, Darlington, which were recently acquired by the Blake Boiler, Wagon and Engineering Company, Limited, have now been remodelled for the manufacture of the company's boiler, and also a high-capacity railway rolling stock and bridge and constructional iron and steel work.

TRADE TALK.

DURING the month another official reduction of 2s. per ton has been declared on all grades of Lincolnshire pig-iron.

ROBERT STEPHENSON & COMPANY, LIMITED, propose reducing the capital of the company from £500,000 to £262,500.

THE average realised net price of manufactured iron in Scotland during the first two months of this year was £6 1s. 0.59d. per ton.

T. CRAPPER & COMPANY, LIMITED, engineers, Marlborough Road, Chelsea, S.W., have secured a site in Fulham Road for new works.

ISAAC STOREY & SONS, LIMITED, of Manchester, have acquired the rights of the water softeners and purifiers patented by T. Roland Wollaston.

NASMYTH, WILSON & COMPANY, LIMITED, are having large boiler-erecting workshops built close to their Bridgewater Foundry, Patricroft, near Manchester.

THE ASSOCIATED IRONMOULDERS OF SCOTLAND have secured a site at 221, West George Street, Glasgow, at a cost, it is said, of £6,800, for the purpose of new offices.

A DISSOLUTION of partnership is notified in connection with Messrs. G. Brown and R. Howie, engineers, Chesterfield, who traded under the style of Brown & Howie.

THE London business of Jones, Brothers & Company, Limited, of Wolverhampton, has been removed from 38, Wilson Street, Finsbury, E.C., to Bangor House, Shoe Lane, E.C.

MR. R. WEATHERBURN, M.I.Mech.E., has been appointed by A. Borsig, of Berlin, as their sole British representative, with offices at Finsbury Pavement House, London, E.C.

MESSRS. HILL & BOALER, of Stourbridge, have appointed Mr. H. T. Middleton, of 28, Martin's Lane, Cannon Street, London, E.C., as their London export agent.

THE ELECTRICAL COMPANY, LIMITED, Charing Cross Road, London, W.C., have severed their connection with Mr. Lestock-Forbes, manager of their Newcastle branch.

THE business of Messrs. John Taylor & Company, of 12 and 14, Dean Street, Newcastle-on-Tyne, has, for family reasons, been converted into a private limited concern.

W. Sisson & Company, Limited, Gloucester, have appointed Messrs. Agnew & Donaldson, of 25, Victoria Street, S.W., as their representatives in London and district.

Wm. Whitwell & Company, Limited, Thornaby Iron Works, Stockton-on-Tees, have appointed Mr. T. H. Watson, 24, Norfolk Row, Sheffield, as their Sheffield district representative.

The Consett Iron Company, Limited, have appointed Mr. F. W. Jackson, 224, Corn Exchange, Cathedral Street, Manchester, to act as their Lancashire and Cheshire representative.

The average selling price of No. 3 G.M.B. Cleveland pig-iron for the first quarter of the year has been ascertained as 50s. 4.48d., as against 47s. 5.82d. for the previous three months.

Messrs. Parkes & Company, Limited, Tipton, are making for the Admiralty a chain of 4½ in. diameter, the breaking strength of which is stated to be beyond the power of any existing machine.

Mr. C. R. Heap, supplier of electrical and mechanical appliances, 28, Hatton Garden, London, E.C., has taken into partnership Mr. E. Johnson, and in future will trade under the style of Heap & Johnson.

A number of high pressure boilers for the Japanese Government's new explosive works will shortly be shipped from the Clyde. The boilers are of the Lancashire type, and are being made by Arnott & Company, of Coatbridge.

Hadfield's Steel Foundry Company, Limited, contemplate extensive improvements at their East Hecla Works, Sheffield. For this purpose the company have made an additional issue of 4½ per cent. preference shares.

The American Car and Foundry Company, of Trafford Park, Manchester, have secured a contract for 230 freight wagons, fitted with steel underframes, and two four-wheeled bogies, for the Antofagasta (Chili) and Bolivia Railway.

It has been arranged that the International Association for Testing Materials shall this year meet in the Academy of Science at Brussels, from September 3 to 8. Mr. J. E. Stead, F.R.S., Middlesbrough, is the English secretary of this Institution.

The Darlington Forge Company, Limited, are now engaged upon the forgings for the battleship "Lord Nelson," which is fast approaching the launching stage at Messrs. Palmer's Shipbuilding and Iron Company's yard at Jarrow-on-Tyne.

Efforts are being made in Glasgow to make technical education more attractive to the apprentices at the various engineering works in the vicinity. In this respect it is interesting to note that Mr. H. Reid, of the North British Locomotive Company, Limited, has founded the "Hyde Park" gold medal for engineering.

Sir Walter N. Fisher, the receiver and manager on behalf of the debenture holders in *re* J. & S. Roberts, Limited, has ceased to carry on trade at the Swan and Small Heath Foundries, West Bromwich, except for the purpose of collecting outstanding debts due to him, and the goodwill and trade name of the business have been sold to Mr. S. A. Roberts, of The Leasowes, West Bromwich.

The Vulcan Foundry, Limited, of Newton-le-Willows, have been awarded a contract for 18 mixed-traffic locomotives, and 20 compound goods locomotives, for the Buenos Ayres Great Southern Railway, in addition to which the company are to build for the same railway eight six-wheeled coupled bogie express passenger compound locomotives. The same company have been commissioned to build 17 standard type goods engines and a crane locomotive for the Oudh and Rohilkhund Railway.

Messrs. John Wood & Sons, of Barley Brook Foundry, Wigan, are to be congratulated upon the speed with which they executed a recent order for a pair of geared hauling engines for a colliery in Japan. The dimensions of the same were: 18 in. cylinders by 30 in. stroke, geared 2½ to 1. Drum 7 ft. diameter and 3 ft. wide, complete with clutch and brake gear, steam pipes and throttle valve. The order was placed on March 1, the engines were inspected and running under steam on the 24th of the same month, and three days afterwards they were delivered at Birkenhead.

—o—

NEW COMPANIES.

Leicester Engineering Company, Limited.—Capital, £2,000.

Metallic Flexible Tubing Company, Limited.—Capital, £100, in £1 shares.

ARMITAGE & CROSLAND, LIMITED.—Capital, £4,000, to acquire the engineering business of Armitage & Crosland.

WILLINGSWORTH IRON COMPANY, LIMITED.—Capital, £25,000, to take over the business of the Willingsworth Iron Company.

GITTINGS PATENT IRON AND STEEL COMPANY, LIMITED.—Capital, £7,000, to acquire the Wisemore Iron and Steel Works, Walsall.

PATENT INDENTED STEEL BAR COMPANY, LIMITED.—Capital, £10,000, in £1 shares. Registered office: Queen Anne Chambers, Westminster, S.W.

THE WILSON-WOLF ENGINEERING COMPANY, LIMITED.—Capital, £3,000, in £1 shares. Registered office: Laycock's Mill, Thornton Road, Bradford.

WELLINGTON STEEL WORKS COMPANY, LIMITED.—Capital, £16,000, in £1 shares. Registered office: Wellington Works, Rockingham Lane, Sheffield.

CONE-JACKSON ENGINEERING COMPANY, LIMITED.—Capital, £1,000, in 2s. 6d. shares. Registered office: Dunedin House, Basinghall Avenue, E.C.

EDWARD WOOD & COMPANY, LIMITED.—Capital, £100,000, in £1 shares, to acquire the engineering business carried on by Edward Wood & Company, Limited.

ALBERT COOPER, LIMITED.—Capital, £1,500, in £1 shares, to acquire the ironfounding business carried on at Cardale Works, Blackheath, Staffs, by Albert Cooper.

LAWDEN FOUNDRY COMPANY, LIMITED.—Capital, £5,000, in £1 shares, to acquire the business known as the Lawden Foundry, 37, Lawden Road, Bordesley, Birmingham.

THOMPSON BROTHERS, LIMITED.—Capital, £12,000, to take over the business carried on at the Bradley Boiler and Engineering Works, Bilston, as Thompson Brothers.

F. SAVAGE & COMPANY, LIMITED.—Capital, £2,000, to carry on the business of engineers, etc. Registered office: Stanley Works, Oxford Road, New North Road, Islington, N.

CHURCHILL MACHINE TOOL COMPANY, LIMITED.—Capital, £50,000, to acquire the business carried on by Charles Churchill & Company, Limited, at Pendleton, Manchester.

T. WILLIAMS, TILTON ROAD WORKS, LIMITED.—Capital, £5,000, to acquire the business of manufacturers of iron chains, carried on at Tilton Road, Small Heath, Birmingham, by Thomas Williams.

THE BRYAN DONKIN COMPANY, LIMITED.—Capital, £100,000, in £1 shares, to acquire the business carried on as Bryan, Donkin & Clench, Limited, and to carry on the business of engineers, ironfounders, etc.

SANDY MOUNT FOUNDRY COMPANY, LIMITED.—Capital, £3,000, in £10 shares, to take over the business carried on at Llanelly as Davies, Ridley & Company. Registered office: Sandy Mount Foundry, Pembrey Road, Llanelly, Carmarthen.

CENTRAL FOUNDRY COMPANY, LIMITED.—Capital, £2,000, in £1 shares, to take over the business of iron and brass founders carried on at Orchard Street, Newcastle, as the Central Foundry Company. Registered office: "A" Floor, Milburn House, Dean Street, Newcastle-on-Tyne.

—o—

OBITUARY.

SIR DAVID DALE, the well-known North of England ironmaster.

MR. J. B. PETTER, of the Petroleum Engine and Nautilus Works, Yeovil.

MR. W. P. MARSHALL, a well-known Birmingham railway engineer.

MR. DAVID EVANS, of the Eagle Foundry, Llandaff, at the age of 69 years.

MR. ALFRED BOWEN, of the brass foundry, Crumlin, at the age of 59 years.

MR. JOHN FORBES, of the firm of Forbes & M'Barnet, consulting engineers, Glasgow.

MR. J. M'LELLAN BLAIR, one of the directors of the firm of P. & W. M'Lellan, Glasgow.

MR. J. S. SCOTT, a director of the well-known firm of Walter Scott, Limited, aged 41 years.

MONSIEUR MAURICE GENY, the manager of the Creusot Works of Messrs. Schneider & Company.

SIR AUGUSTUS HELDER, who had practically a life-long connection with Whitehaven coal and iron industries.

MR. J. LANG, the founder of the well-known firm of John Lang & Sons, lathe manufacturers, Johnstone, at the age of 81.

MR. J. STIRK, head of the firm of John Stirk & Sons, engineers' toolmakers and ironfounders, Halifax, at the age of 67 years.

MR. V. G. BEARDSHAW, member of the firm of J. Beardshaw & Son, Limited, the Baltic Steel Works, Sheffield, at 83 years of age.

MR. A. HAIGH, managing director of John Haigh & Sons, Limited, Priest Royd Iron Works, Firth Street, Huddersfield, aged 76 years.

MR. W. COOK, of William Cook & Sons, Limited, Glasgow Steel Works, Sheffield, and Glasgow Saw and File Works, Cranston Hill, Glasgow.

MR. G. B. CRAIG, one of the principal partners of the firm of Messrs. Craig, Taylor & Company, shipbuilders and engineers, of Thornaby.

MR. W. FRANKLIN, who was for many years associated with the firm of John Brown & Company, Limited, at the Atlas Works, as manager of the armour plate mill.

MR. CHARLES STEER, one of the managing directors of Guest Keen & Nettlefolds, Limited, one of the oldest officials connected with the company, having been attached to the original firm of Nettlefolds & Chamberlain.

MR. D. J. PARSONS, eldest son of Mr. David Parsons, the veteran mining engineer and ironfounder. The deceased was also the managing director of Parsons (Brierley Hill), Limited, Leys Iron Foundry, and David Parsons & Sons, Cradley Heath.

MR. H. P. CHAPPELL, senior partner of Messrs. Bailey, Pegg & Company, engineers and ironfounders, Brierley Hill and London. The Company's original foundry was near Blackfriars Bridge, London, the Brierley Hill foundry being established in the reign of George III. The deceased was 74 years of age.

MR. J. T. SMITH, Past-President of the Iron and Steel Institute and the British Iron Trade Association, and a director of the Otis Steel Company, Limited, and of Richard Thomas & Company, Limited. The deceased gentleman was for many years, in the earlier part of his life, the manager of the Barrow Hematite Steel Company's Works.

—o—

MR. A. FEATHERSTONE, managing director of C. & W. Walker, Limited, has retired, but will retain his seat on the board. Mr. H. F. Wright, for many years connected with Ashmore, Benson, Pease & Company, has succeeded Mr. Featherstone.

PERSONAL.

SIR WILLIAM and LADY CROOKS celebated their golden wedding on April 10 last.

MR. JOHN HALL, of Hall & Pickles, Limited, Manchester, is now in the United States.

MR. G. H. THOMSON has been elected a director of P. & W. McLellan, Limited, of Glasgow.

THE late Colonel C. Lowthian Bell left estate valued at £182,864 gross and £176,830 net.

SIR HUGH BELL, BART., has been appointed Lord-Lieutenant of the North Riding of Yorkshire.

MR. E. PARKES, M.P., has been added to the Advisory Committee of the Board of Trade on Commercial Intelligence.

MR. FRITZ W. LUERMANN, of Berlin, has been awarded the Karl Lueg medal by the German Iron and Steel Institute.

THE late Mr. G. H. Wall, of Messrs. Dewrance & Company, engineers, Southwark, left estate valued at £17.221 gross.

THE estate of the late Mr. H. White, formerly managing director of the Risca Foundry, Newport, has been valued at £21,986 net.

MR. R. SMITH, of the Fairfield Company's staff, is succeeding Mr. E. Griffith as manager of the engine department of Messrs. Barclay, Curle & Company.

MAJOR R. DOBBIE, of Messrs. Dobbie, Forbes & Company, will preside over the anniversary banquet of the Royal Metal Trades' Pension Society on May 29.

MR. H. H. SANDERSON, manager to the Falkirk Iron Company, has been appointed manager to Messrs. Yates, Haywood & Company, Limited, Rotherham.

MR. H. J. DONKIN will act as London director of the Bryan Donkin Company, Limited, and Messrs. G. Clark and A. G. Webb as local directors at Chesterfield.

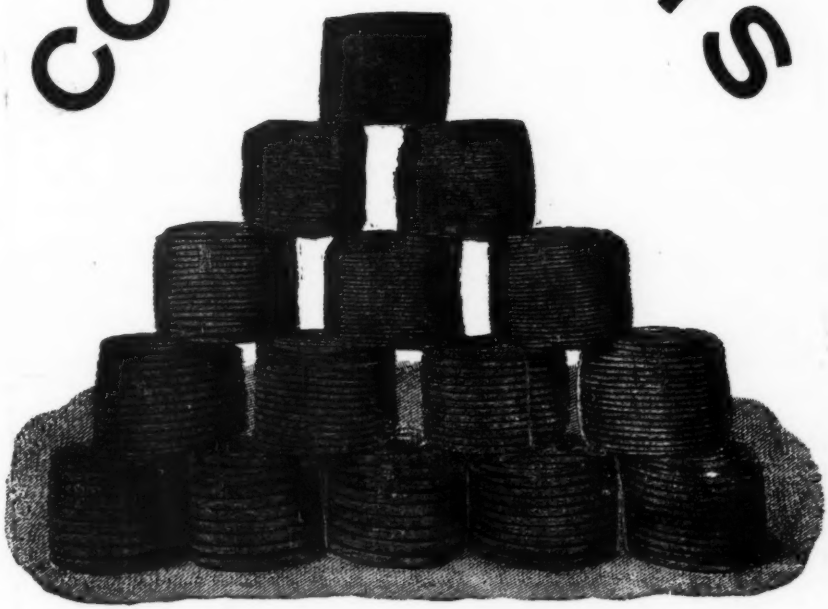
MR. H. MACMILLAN, of the staff of Swan, Hunter & Wigham Richardson, Limited, has been appointed general manager of the Ailsa Shipbuilding Company, Limited.

MR. G. HENDRY, a representative of the Forth and Clyde and Sunnyside Iron Company, Limited, has been appointed a representative of the Dorrator Iron Company, Limited, of Falkirk.

MR. GEORGE SENIOR, chairman of George Senior & Sons, Limited, Ponds Forge,

EVANS'S

CORE VENTS



$\frac{1}{16}$, $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$ & $\frac{1}{2}$ diameter.

AS SUPPLIED TO H.M. GOVERNMENT

AND

ALL THE LEADING FOUNDERS.

JAMES EVANS & CO.,

Britannia Works,

MANCHESTER.

Telegrams { "LADLES, MANCHESTER."
"BLACKINGS, GLASGOW."

Sheffield, has been somewhat dangerously ill of late, but is now making satisfactory progress towards recovery.

MR. J. ANDERSON, of the Scottish Central Iron Company, Limited, Falkirk, and Mr. J. Blair, ironfounder of Bonnybridge, have been elected members of Falkirk Parish School Board.

MR. T. PICKARD, chairman of the Birmingham Railway Carriage and Wagon Company, Limited, has resigned, and has been succeeded by Mr. G. Beech. Mr. Pickard retains a seat on the board.

THE Secretary of State for India has nominated Mr. A. Brereton to represent the India Office on the Sectional Committee of the Engineering Standards Committee on Locomotives in the place of Sir Frederick R. Upcott, chairman of the Indian Railway Board. The Council of the Institution of Naval Architects have nominated Mr. S. W. Barnaby, of Messrs. John I. Thornycroft & Company, to represent that institution on the Sectional Committee on Screw Threads and Limit Gauges in the place of Mr. McFarlane Gray, resigned.

Ganister, Cupola Blocks, Fire Bricks,

Fire Clay.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

Steel Moulders' Composition, Silica Cement.

J. GRAYSON LOWOOD & Co., Ltd.,

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

ELDERS FOUNDRY COKE

As supplied to the

British . .

Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.

We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

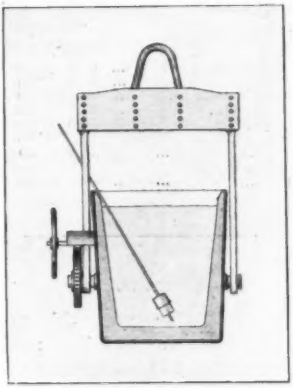
From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

PREVENTION OF BLOWHOLES IN CAST IRON.



A tin of our special compound fixed on a rod is held at bottom of ladle as shown; a strong re-action being thereby set up frees the iron from gases and impurities, which rise to the top.

RESULT: A denser casting of finer grain with increased strength.

For Particulars apply to—

THERMIT LIMITED,

27, MARTIN'S LANE, CANNON STREET,

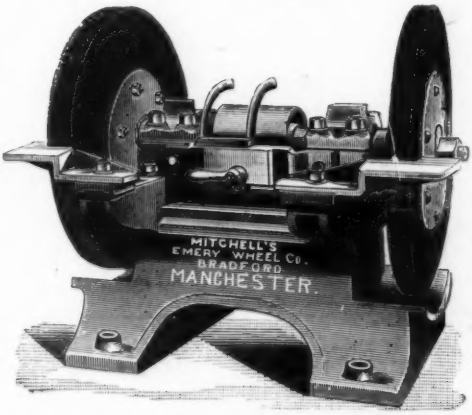
Telephone—3749 Central.
Telegrams—"Fulmen," London.

LONDON, E.C.

MACHINES For all Purposes. **WHEELS.**

Complete with Emery or Corundum Wheels from **£2** upwards.

Special Machines Designed.



Emery or Corundum from 1 in. x $\frac{1}{8}$ in. to 50 in. x 12 in.

Enquiries solicited.

MITCHELL'S EMERY WHEEL Co.,

Mill Street, Bradford, MANCHESTER.

Also at LONDON, GLASGOW, and BELFAST.

LISTS FREE.

PRICES OF METALS

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

METALS	1905-6.	1904-5.
Iron—Scotch pig warrant ... ton	—	52/6
—Middlesbro' warrants ... ... ton	48/11	53/9
—W.C. M/nos Bessemer ... ... ton	67/0	58/6
—Stock, Scotch, Mar. 31 ...tons	12,635	18,000
Copper—Chill bars, GMB ... ... ton	£85 2/6	£65 10/0
—Stock, Europe & afloat... ... tons	9,138	18,055
Tin—English ingots ton	£184 0/0	£139 0/0
—Straits ... ton	£183 10/0	£138 12/6
—Stock, Ldn. Hlnd and afit ... tons	12,353	12,824
Lead—English pig ton	£16 6/3	£12 17/6
Spelter—Ord. Silesian ... ... ton	£26 15/0	£23 12/6
Quicksilver-(75lb.) bottle	£7 5/0	£7 7/6
Antimony—Regulus ... ... ton	£105 0/0	£36 0/0

*Settlement price, sellers, cash.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	6 12 6	to	7 2 6
Pipes, 1½ to 2½ in.	5 0 0	to	5 2 6
,, 3 to 4 in....	4 12 6	to	4 15 0
,, 5 to 8 in.	4 10 0	to	4 12 6
,, 10 to 16 in....	4 10 0	to	4 12 6
,, 18 to 24 in....	4 10 0	to	4 12 6
Chairs	3 15 0	to	3 17 6
Floor plates (open sand)	3 0 0	to	3 5

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows: — Heavy wrought (mixed), £2 12s. 6d.; light wrought, £1 5s.; heavy cast, £2 5s.; all per ton f.o.b., London. Copper (clean), £52; brass (clean), £78; lead (usual draft), £14 10s.; tea lead, £12 10s.; zinc, £21; all per ton delivered merchants yard.

SILICA FIRE BRICK Co.,

OUGHTIBRIDGE.

GROUND GANISTER,

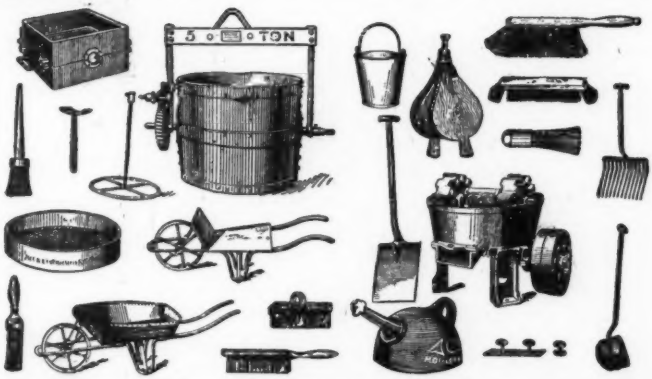
Wet or Dry.

Silco Cupola Bricks, 90 % Silica.

Better than Fire-clay Bricks for Cupolas.

Established 1863.

Jas. Durrans & Sons,



PHŒNIX WORKS, PENISTONE, Near Sheffield.

Manufacturers of all

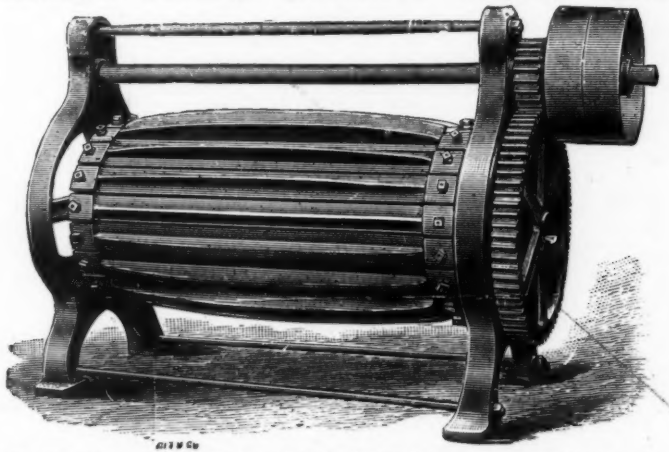
FOUNDRY EQUIPMENTS,

Composition Black Lead,

Plumbago, Core Gum, White Dust, and Coal Dust.

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, &c.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

"Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD."

Patent Hydraulic Core-Making Machine. Hydraulic Moulding Machine.
For Pipe Founders.

Sand-Preparing Machines, Tumbling Barrels, Core Ovens, &c., &c.

THE LONDON EMERY WORKS CO.,

DEPT. "C," **PARK, TOTTENHAM, N.**

SITUATIONS VACANT AND WANTED.

FOREMAN MOULDER.—First-class Foreman Moulder (non-Society) Wanted; one who can take charge of loam, drysand, and greensand, and accustomed to castings up to 12 tons. Large jobbing shop, making all kinds of castings, including marine work. Applicants must be 6 o'clock men, and must be able to give moulding costs either from patterns or from drawings; must possess a thorough knowledge of costs of labour, and one accustomed to piecework preferred.—State experience, wages expected, etc., and apply by letter to "Moulder," J. M. MUNRO, LTD., 123, Hope Street, Glasgow.

TO BRASS-FOUNDERS & ENGINEERS.—Complete Analysis of any alloy, 25/-. L. PARRY, A.R.S.M., Union Bank Yard, Huddersfield. Speciality—Brasses, Bronzes and Anti-Friction Metals. Twelve years' experience.

FOR SALE AND WANTED.

FOR SALE, "Root's" Patent Foundry Blowers, &c.

No. 2 size by	"Thwaites"	8 in. outlet	£22.
No. 1 ,,	"Allday's"	7 in. ,,	£20
No. 1A ,,	,,	6 in. ,,	£20.
No. 3 ,,	"Wilkinson"	6 in. ,,	£17.

Two 7 ft. by 4 ft. Vertical Boilers, as new, each... ... ... £34.

For full details address J. LIGHT, Wolverhampton.

CRUCIBLE STEEL CASTINGS for Collieries, Works, and Engineers, from customers' patterns; machined if desired.—P. T. WOODRUFF AND CO., Machen, Newport, Mon.

EVERY IRONFOUNDRY should use Hall's Improved Centrifugal Sand Grinder and Mixer, which utilise the waste sand from the Foundry, and makes it in the best possible condition for Moulding High Class Castings. Capacity 4 tons per hour. Price and Particulars, apply to J. S. HALL & CO., LTD., Midland Ironworks, Newark on-Trent.

ROOTS BLOWERS.

Two Belt-driven, Number 4, by Thwaites Bros.
One Engine combined, Number 4, with No. 5 Engine, by Thwaites, Bros.,

FOR SALE.

Can be inspected at JOHN ADAMS & SONS, Machinery Stores, Newcastle-on-Tyne.

FOR SALE.

Scott's Wheel Moulding Machine, equal to new.
New 3 ft. 6 in. and 4 ft. 6 in. pan, Loam and Sand Mill.
New Moulding Sand Mixer. Capacity, 5 to 10 tons per hour.
Thwaite's Root's Blower, 11½ in. discharge.
Thwaite's Root's Blower, combined with Vertical engine. Melting capacity, 3 tons per hour.
No. 4 Root's Blower, by Alldays, to blow 50 fires.
30 in. Revolving Blast Fan.
No. 3 Sturtevant High-pressure Fan, 24 in. diameter.
No. 1 Silent Blowing Fan, suitable for 7 fires, 11 in. diameter.
Blowing Fan by Lloyd, 36 in. diameter.
New Patent Noiseless Fan ... for 9 fires.
Do. Do. ... for 2 fires.
Do. Do. ... for 6 fires.
Do. Do. ... for 4 fires.
Do. Do. ... for 8 fires.
Do. Do. ... for 12 fires.
Two New Patent Noiseless Fans for 16 fires.
Two Exhaust Fans, 5 in. and 6½ in. inlet.

Send for Illustrated List of Phillips' New Improved Foundry CORE OVENS.

IRON AND BRASS CASTINGS.

Note the ONLY ADDRESSES:—

CHARLES D. PHILLIPS,

Emlyn Engineering Works and Foundry, NEWPORT, MON., AND GLOUCESTER.

JAMES DOUGALL & SONS, LTD.,

BONNYBRIDGE, N.B.

Foundry Specialists.

GANISTER, FIREBRICKS, GANISTER BRICKS, FIRECLAY,
Of the Highest Qualities.

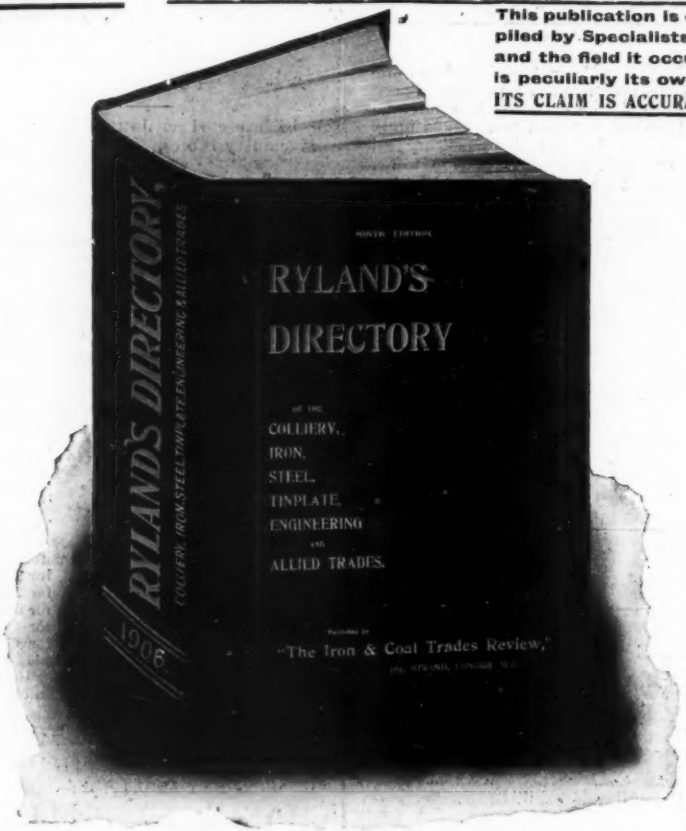
If you are troubled with Defective Fire-Resisting Materials write for Prices.

SHIPPING PORTS:
Glasgow, Bo'ness, Grangemouth and Leith.

LISTS!

HAVE YOU A GOOD LIST OF FOUNDRIES, IRON, STEEL, ENGINEERING WORKS AND COLLIERIES?

This publication is compiled by Specialists, and the field it occupies is peculiarly its own. ITS CLAIM IS ACCURACY.



RYLAND'S DIRECTORY has been the recognised authority for a quarter of a century in the trades to which it appeals.

Its staff is largely composed of Engineers who have either served their time in the shops, or are technically educated. This expert sifting means a great monetary saving to those requiring a directory.

If you are desirous of pushing your business in the Colliery, Iron, Steel, Tinplate and Engineering Trades, either as Producer, Manufacturer, Merchant, Agent, Traveller, etc., it would prove most valuable to you.

NINTH EDITION, 1906,

NOW READY.

Price (Prepaid) 25/- Nett.

CLOTH BOUND.

CUT THIS OUT.

SUBSCRIPTION ORDER FORM.

Enclosed please find.....value 25/- for the 1906 issue of Ryland's Directory.

Name.....

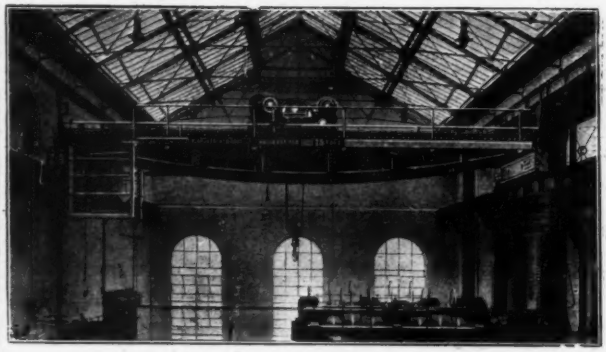
Address .....

.....

CUT THIS OUT.

Publishing Offices: **EAGLAND & Co., Ltd., 165, STRAND, London, W.C.**

ELECTRIC CRANES!



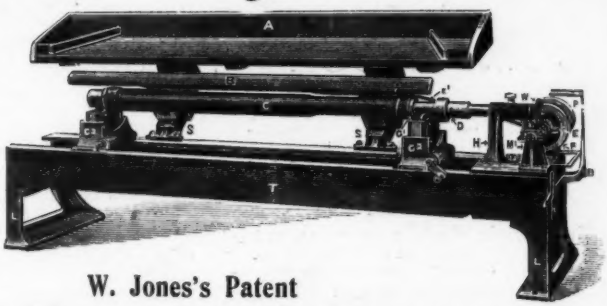
Up to
100
TONS
Capacity.

Send for
our New
Catalogue.

THOMAS BROADBENT & SONS, Ltd.,
HUDDERSFIELD.

A REVOLUTION IN
Pipe Foundry Practice

For
Pipe Cores,
18 ft. long and
2 in. to 20 in.
diameter.



W. Jones's Patent
CORE FORMING MACHINE

JONES & ATTWOOD,
STOURBRIDGE, ENGLAND.

The "LEEDS" Dead Length Core Machine.

This machine is made in three sizes with capacities up to 8½ inches, and special arrangements for larger sizes. It is of British manufacture.

Some of our other specialities are Cupolas, Ladles, Mixers, Core Machines (two types), Moulding Machines (Pneumatic, Turnover and Hand-press), Pneumatic Chippers, Pneumatic Rammers, Pneumatic Riddles (three types), Bar Testing Machine, Tumbling Barrel, Overhead Trolley Track, Foundry Sundries.

HORACE P. MARSHALL & CO.,
LEEDS.

£100
WILL BUY
A COMPLETE
COMPRESSED AIR
INSTALLATION,
INCLUDING
"Boreas" Air Compressor, Receiver, Chipping Hammers, Hoists, Sand Blast Apparatus or other Appliances.
ALL OF THE BEST KIND.
Every works should possess one, as it will pay for itself in a very short time.

FURTHER PARTICULARS FROM
LACY-HULBERT & Co., Ltd.,
PNEUMATIC ENGINEERS
91, Victoria St., London, S.W.
—— AND BOREAS WORKS, BEDDINGTON. ——

WHAT IS

S M S?

SWIFT METALLIC STOPPING

THE NEW FOUNDRY CEMENT.

IT is used for filling up blow holes and sand holes in Cast Iron or Steel Castings.
IT is supplied in powder form and mixed for use with a little water to a stiff paste.
IT dries on a casting in 1 hour, and can be filed up bright in from 6 to 12 hours.
IT is specially useful to all Engineers, Machinists, Foundrymen, &c.
IT is of British Manufacture.

A Small Sample sent Post Free on receipt of your address, or a trial 1 lb. Tin Post Free on receipt of P.O. or Stamps for 1s. 6d.

THE SILENT MACHINE AND ENGINEERING CO., ALBION WORKS, SHEFFIELD.

On Admiralty, War Office, and India Office Lists.

FOR

BLACKINGS, &c.,

SEND TO

THOMAS WILKINSON & CO., LTD.,

MIDDLESBROUGH.

Half Cwt. Samples sent Free, Carriage Paid, to good Buyers for trial if required.

- - THE - -

PHOSPHOR BRONZE Co., LTD.,

87, SUMMER STREET,
SOUTHWARK, LONDON, S.E.

Cog Wheel Brand
Phosphor Bronze Alloys.
Phosphor Tin (5%).
Phosphor Copper (10% & 15%).

BLACK DELPH FIREBRICKS

For High Temperatures.

Also Special Grades for
CUPOLA LININGS STEEL FURNACES,
BRASS FURNACES.

CRUCIBLE CLAYS.

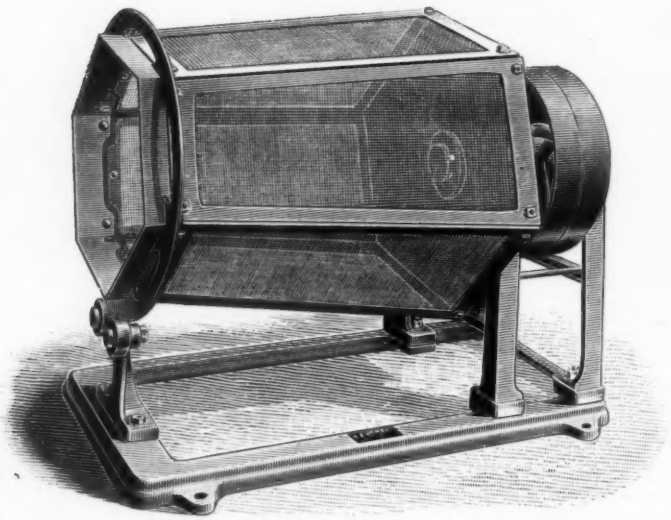
E. J. & J. PEARSON, LTD.

STOURBRIDGE.

38½"
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical and metallurgical processes. List of sections and prices on application t
CHAS. McNEIL.
KINNING PARK IRONWORKS,
GLASGOW.
36"
32½"

Can also be made in Aluminium.

EVANS'S
ROTARY . . .
SANDSIFTERS.



AS SUPPLIED TO H.M. GOVERNMENT
AND
ALL THE LEADING FOUNDERS.

Everything FOR THE Founders.

JAMES EVANS & CO.,

Britannia Works,

Telegrams { "Ladles, Manchester." / "Blackings Glasgow." }

MANCHESTER.